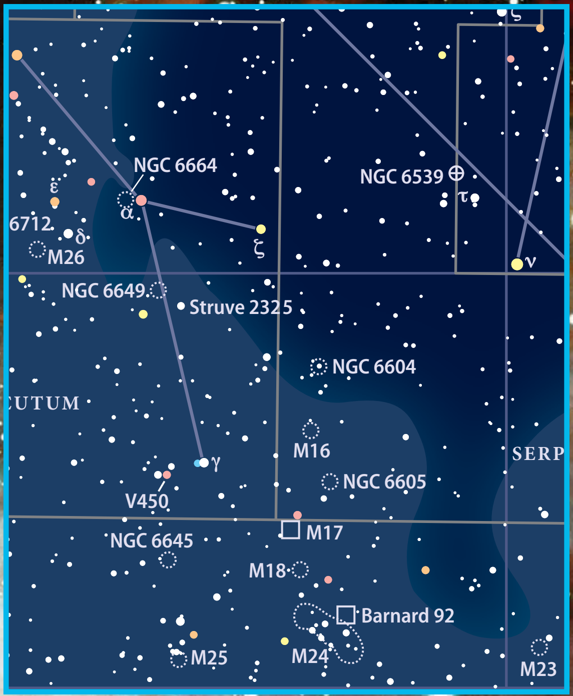
Astronomy®
special issue

A must-have for all stargazers

NEW EDITION!

ATLAS of the STARS


NGC 6664
NGC 6539 ⊕
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ν
NGC 6649
Struve 2325
NGC 6604
UTUM
SERP
M16
γ
V450
NGC 6605
M17
NGC 6645
M18
Barnard 92
M25
M24
M23

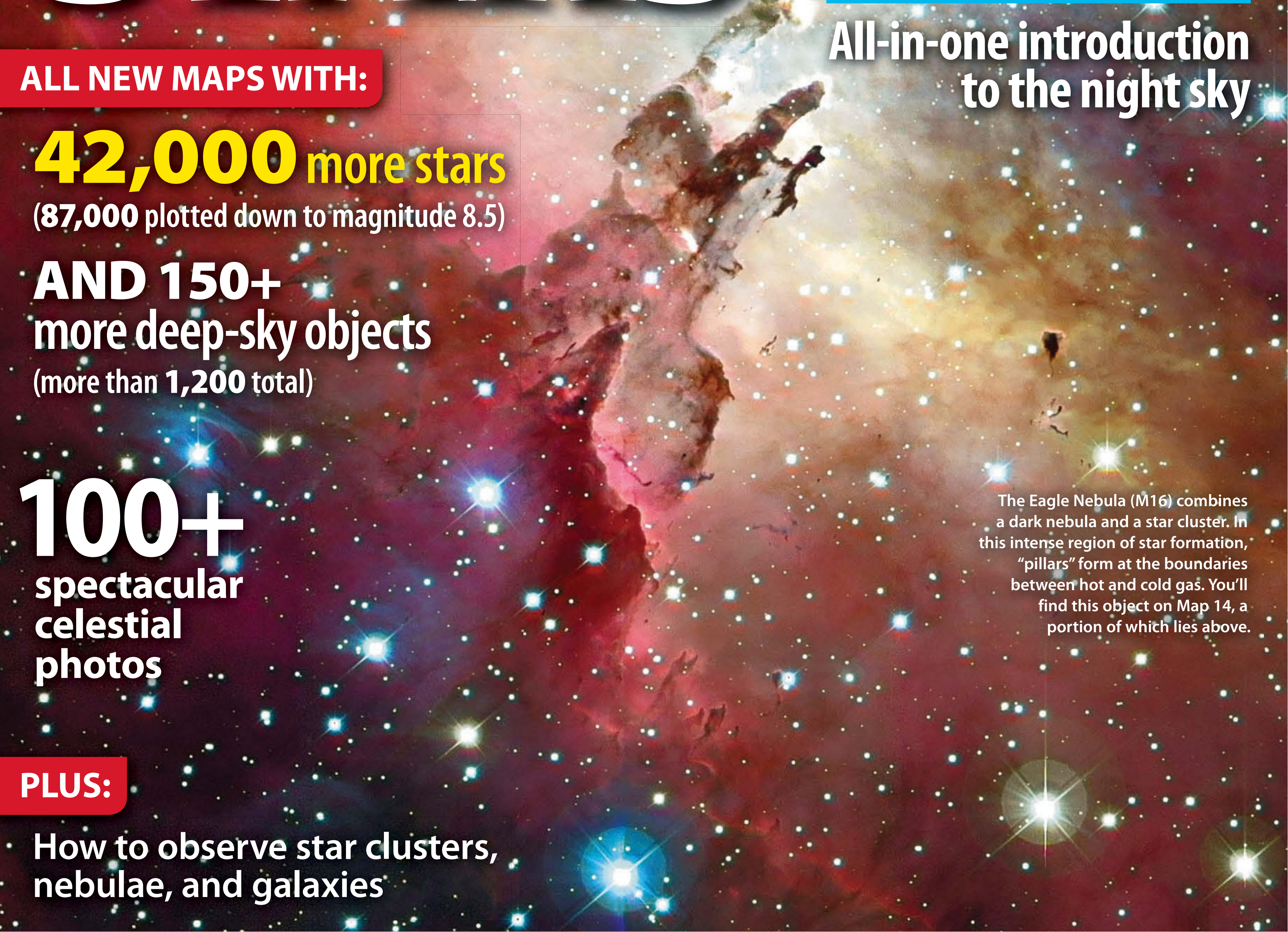
All-in-one introduction to the night sky

ALL NEW MAPS WITH:

42,000 more stars
(**87,000** plotted down to magnitude 8.5)

AND 150+
more deep-sky objects
(more than **1,200** total)

100+
spectacular celestial photos



The Eagle Nebula (M16) combines a dark nebula and a star cluster. In this intense region of star formation, "pillars" form at the boundaries between hot and cold gas. You'll find this object on Map 14, a portion of which lies above.

PLUS:

How to observe star clusters, nebulae, and galaxies

Tour the night sky

The staff of *Astronomy* magazine decided to produce its first star atlas in 2006. Although we hoped our readers would enjoy it and use it, we didn't anticipate how popular it would be. Only a few months after it appeared, we were out of copies. A reprint was in order.

A simple redo, however, would not do. As we discussed the project, we decided to keep what worked — the layout, explanations, lists, and great images — and add to the excellent maps. Maps in *Atlas of the Stars: New Edition*, therefore, contain some 42,000 additional stars.

We didn't arrive at that number by accident. We chose to include stars down to magnitude 8.5, a full half-magnitude gain over our first atlas, which displayed 45,000 stars as faint as magnitude 8.0. The extra stars will help binocular observers and amateur astronomers who use telescopes with low-power, wide fields of view.

We also added some 150 deep-sky objects. As with the original batch, you can view most of them through a 6-inch telescope from a dark site.

This atlas presents the sky in five areas. Maps 1 through 3 show the far northern sky (North Polar), and Maps 22 through 24 display the far southern sky (South Polar). Between these extremes lie the North Equatorial (Maps 4 through 9), Equatorial (Maps 10 through 15), and South Equatorial (Maps 16 through 21) regions. Each group of maps progresses in right ascension, and adjoining maps have some overlap so you won't miss anything.

As I stated in my original editorial, to those of you just starting out on your lifelong love affair with astronomy, view this atlas as a beginning, not an end. Let its information and images start you on a tour of the night sky's highlights. Along the way you'll experience our fabulous universe.

Michael E Bakich

Michael E. Bakich

ATLAS GLOSSARY

ASTERISM — An unofficial, recognizable group of visible stars.

CONSTELLATION — One of 88 arbitrary configurations of stars; the officially recognized area of the sky containing one of these configurations.

DECLINATION — An Earth-centered angle that gives an object's position either north (positive declination) or south (negative declination) of the celestial equator.

DOUBLE STAR — Two stars that appear close to one another, linked either physically by gravity or chance alignment.

FIELD OF VIEW — The area visible through the eyepiece of a telescope or through binoculars. Manufacturers measure field of view as an angle. Binoculars, therefore, may have a field of view of 7°.

GALAXY — A collection of dust, gas, and stars held together by gravity; types include elliptical, irregular, and spiral.

GLOBULAR CLUSTER — A spherical collection of old stars found within the outer regions of spiral and elliptical galaxies.

MAGNITUDE (apparent) — the brightness of a celestial object as seen from Earth, irrespective of its true brightness.

MESSIER OBJECT — Any of 109 deep-sky objects cataloged by French astronomer and comet-hunter Charles Messier (1730–1817) to help avoid confusion with possible comets.

NEBULA — (Latin for "cloud") A cloud of interstellar dust and/or gas.

NGC OBJECT — Any of 7,840 deep-sky objects published in the *New General Catalogue* by John L. E. Dreyer (1852–1926) in 1888. The NGC was followed by a supplement of 5,386 additional objects called the *Index Catalogue* (designated IC).

OPEN CLUSTER — Usually young star systems containing between a few hundred and a few thousand stars.

PLANETARY NEBULA — The outer, gaseous layers of a red giant star that have been blown off into space; the gas glows because it is excited by radiation from the central, collapsed star.

RIGHT ASCENSION — An Earth-centered angle analogous to longitude but measured in hours, minutes, and seconds; each hour represents 15° (1⁄24 of a circle).

STAR — A self–luminous sphere of gas that generates energy by nuclear fusion in its core.

NEW EDITION!

ATLAS of the STARS

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Cartographer Richard Talcott
Art Director LuAnn Williams Belter

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Associate Editor Liz Kruesi
Assistant Editor Bill Andrews
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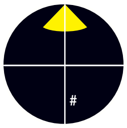


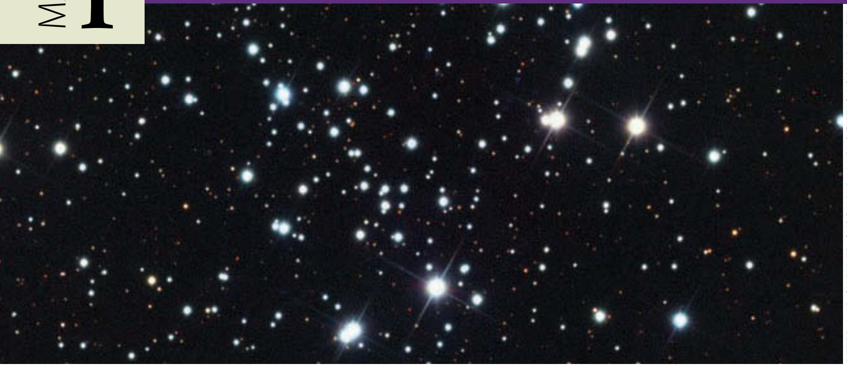
The icon at the upper left of each map shows the area of sky depicted; a label shows the map's central hour of right ascension.

All map planning: Richard Talcott
All map illustrations: Roen Kelly
Cover image: Canada-France-Hawaii Telescope/Coelum

THE RUNNING MAN NEBULA (NGC 1973/5/7): DANIEL VERSCHATSE

NGC 2997: DANIEL VERSCHATSE

CENTAURUS A (NGC 5128): DANIEL VERSCHATSE



PETER AND SUZIE ERICKSON/ADAM BLOCK/NOAO/AURA/NSF

▲ **OPEN CLUSTER NGC 663 in Cassiopeia shines at magnitude 7.1 and measures 15' across. Use 50x or less to observe it.**

The Queen's clusters

Cassiopeia the Queen is the highlight constellation of our first star map. Easily recognized by its W or M shape, many of the celestial targets in this area are open star clusters within Cassiopeia's boundaries. For more on observing these star groups, see "Beacons in the dark: observing open clusters" on page 77.

A notable sight outside Cassiopeia is **Kemble's Cascade** (NGC 1502), which glows at magnitude 5.7 in Camelopardalis the Giraffe. Franciscan amateur astronomer Father Lucian Kemble (1922–1999) first described this chance alignment of stars (it's not a true star cluster). He found it while scanning the sky through binoculars.

Binoculars that yield 15x reveal a dozen stars in a 2.5°-long chain. A small telescope shows 20 stars brighter than 11th magnitude, and through an 8-inch or larger scope, nearly 50 stars pop into view.

If you're new to observing, don't miss the **Double Cluster** (NGC 869 and NGC 884) in Perseus, which lies just to the southeast of Cassiopeia. You can see this bright pair of open clusters with naked eyes, but it's even better through binoculars. A telescope/eyepiece combination that magnifies 40x to 60x allows you to study pairs, triplets, and chains of stars within the clusters.

Two Messier objects inhabit Cassiopeia. **M103** lies 1° east of Delta Cassiopeiae, which is the left bottom star of the prominent W shape marking the Queen's throne. A 6-inch scope reveals three dozen stars grouped in a triangular area 5' across.

Draw a line from Alpha through Beta Cassiopeiae and extend it an equal distance to find **M52** (Map 3). Through an 8-inch scope, you'll see 75 stars clumped in various patterns. M52 lies on the edge of the Milky Way, so its stars aren't lost among the background points of light.

Also on Map 3, find the **Bubble Nebula** (NGC 7635). This object looks best through a 12-inch or larger telescope at a dark site. An 8-inch scope reveals a short arc of gas, but that's about it.

One more open cluster you shouldn't miss is the **Owl Cluster** (NGC 457), which lies less than 3° south of Delta Cassiopeiae. Even a 4-inch scope will show this cluster's two "wings." The eastern wing is a line of four bright stars, and the western wing comprises two pairs of stars arranged in a long rectangle.

You can find the bright spiral galaxy **NGC 2403** in Camelopardalis. Of course, in astronomy, "bright" is a relative term, but this galaxy makes the "top 100" brightest galaxies visible from Earth. Through a 6-inch scope, you'll see an oval patch 7' long with a central brightening.

THE GREEK ALPHABET AND STAR MAPS

Modern-day star designations (excluding proper names like Arcturus and Betelgeuse) date from 1603. In that year, German map maker Johannes Bayer published *Uranometria*, an atlas of the constellations. He plotted more than 2,000 stars, and his system differed from previous charts. Before Bayer, stellar cartographers designated stars by their positions within the mythological figures of the constellations.

Bayer's system used Greek letters to differentiate the brightnesses of stars in a constellation. So the first Greek letter, Alpha (α), usually denoted a constellation's brightest star, Beta (β) was the second-brightest, and so on. Bayer estimated brightnesses by eye, so some discrepancies exist.

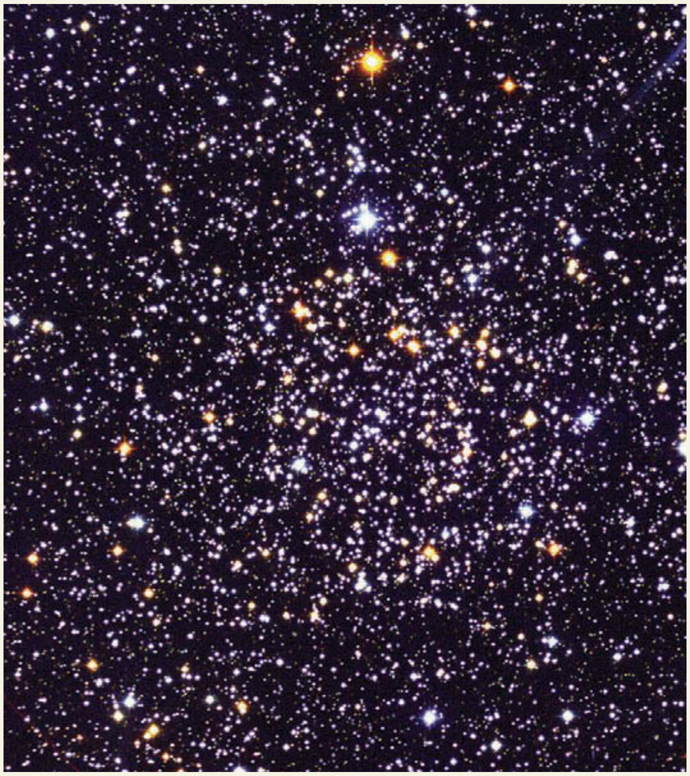
Also, Bayer sometimes lettered stars sequentially. The Big Dipper is an example. Starting at the end of the bowl, Bayer lettered its stars Alpha, Beta, Gamma, Delta, Epsilon, Zeta, and Eta. Since Bayer's time, other celestial cartographers have subdivided some of his letters — for example, in Orion, we now find the stars π^1, π^2, π^3, etc. — but none have added new letters to any constellation.

ASTRONOMY EXTRA Look on each star map for the following box:

α	Alpha	ι	Iota	ρ	Rho
β	Beta	κ	Kappa	σ	Sigma
γ	Gamma	λ	Lambda	τ	Tau
δ	Delta	μ	Mu	υ	Upsilon
ε	Epsilon	ν	Nu	ϕ	Phi
ζ	Zeta	ξ	Xi	χ	Chi
η	Eta	ο	Omicron	ψ	Psi
θ	Theta	π	Pi	ω	Omega

FRED CALVERT/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE DOUBLE CLUSTER IN PERSEUS (NGC 869, right, and NGC 884) is visible to the naked eye, looks great through binoculars, and offers lots of enjoyment to telescopic observers. Use low power for a wide field of view.**



B. J. MOCHEJSKA AND J. KALUZNY (WARSAW UNIV. OBSERVATORY), KPNO

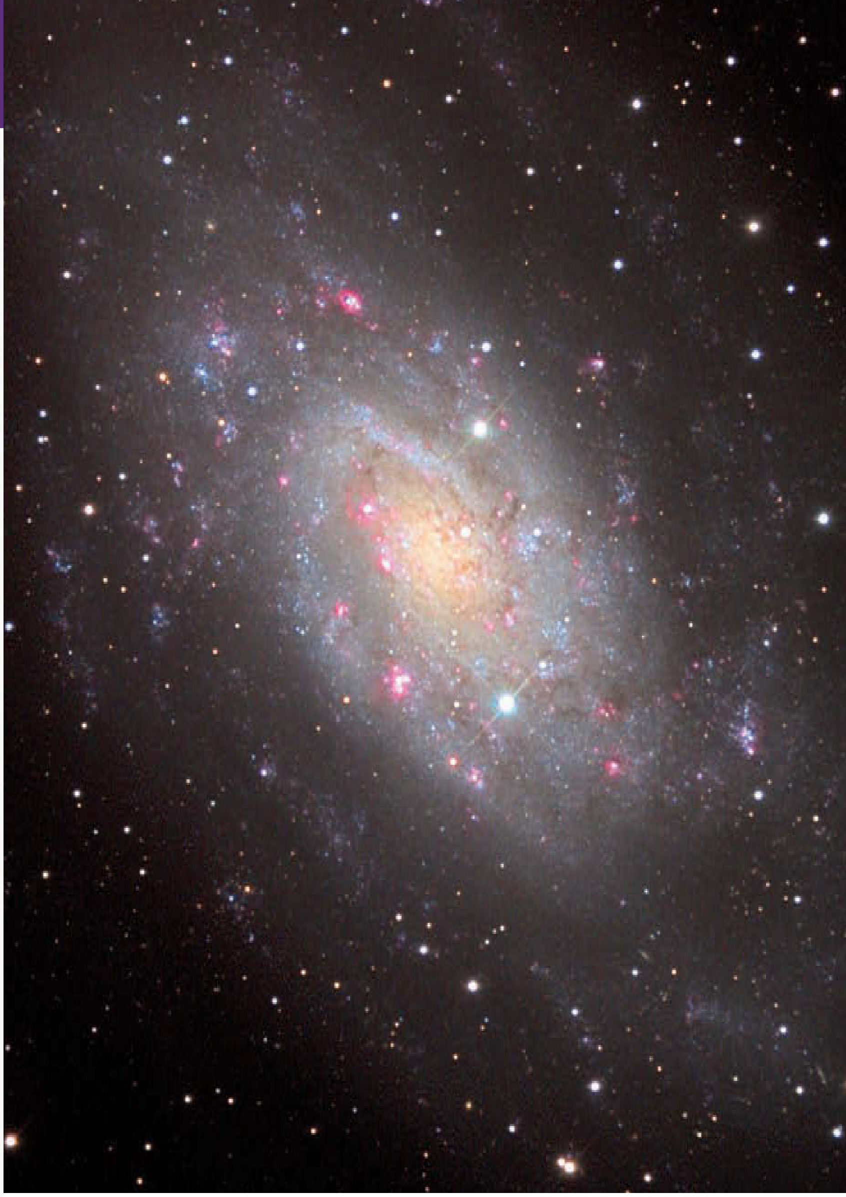
▲ **YOU'D HAVE TO READ through more than 99 percent of the *New General Catalogue* before you'd encounter open cluster NGC 7789.**

THE END OF THE *NEW GENERAL CATALOGUE*

Printed in 1888, John L. E. Dreyer's *New General Catalogue* (NGC) is one of the prime references for bright deep-sky objects. The catalog contains 7,840 entries.

Some well-known NGC objects are the Andromeda Galaxy (NGC 224), the Orion Nebula (NGC 1976), and the Ring Nebula (NGC 6720). Most objects have more than a single designation. For example, these objects also are Charles Messier's catalog entries M31, M42, and M57, respectively.

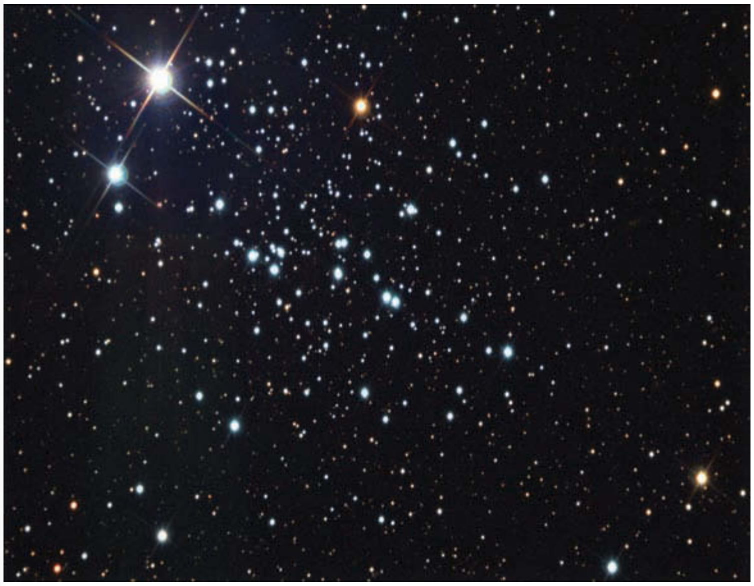
You'll find all objects entered according to their right ascension. Lying at right ascension 23h57m — and thus numbered near the catalog's end — is one of the sky's most spectacular open clusters, NGC 7789 in Cassiopeia (Map 1). A 4-inch scope reveals 50 stars here, and a 12-inch reveals nearly 200 points of light.



▲ **SPIRAL GALAXY NGC 2403 in Camelopardalis moves through space with M81, which lies in Ursa Major. NGC 2403 shines at magnitude 8.4 and lies 12 million light-years distant.** FRED CALVERT/ADAM BLOCK/NOAO/AURA/NSF

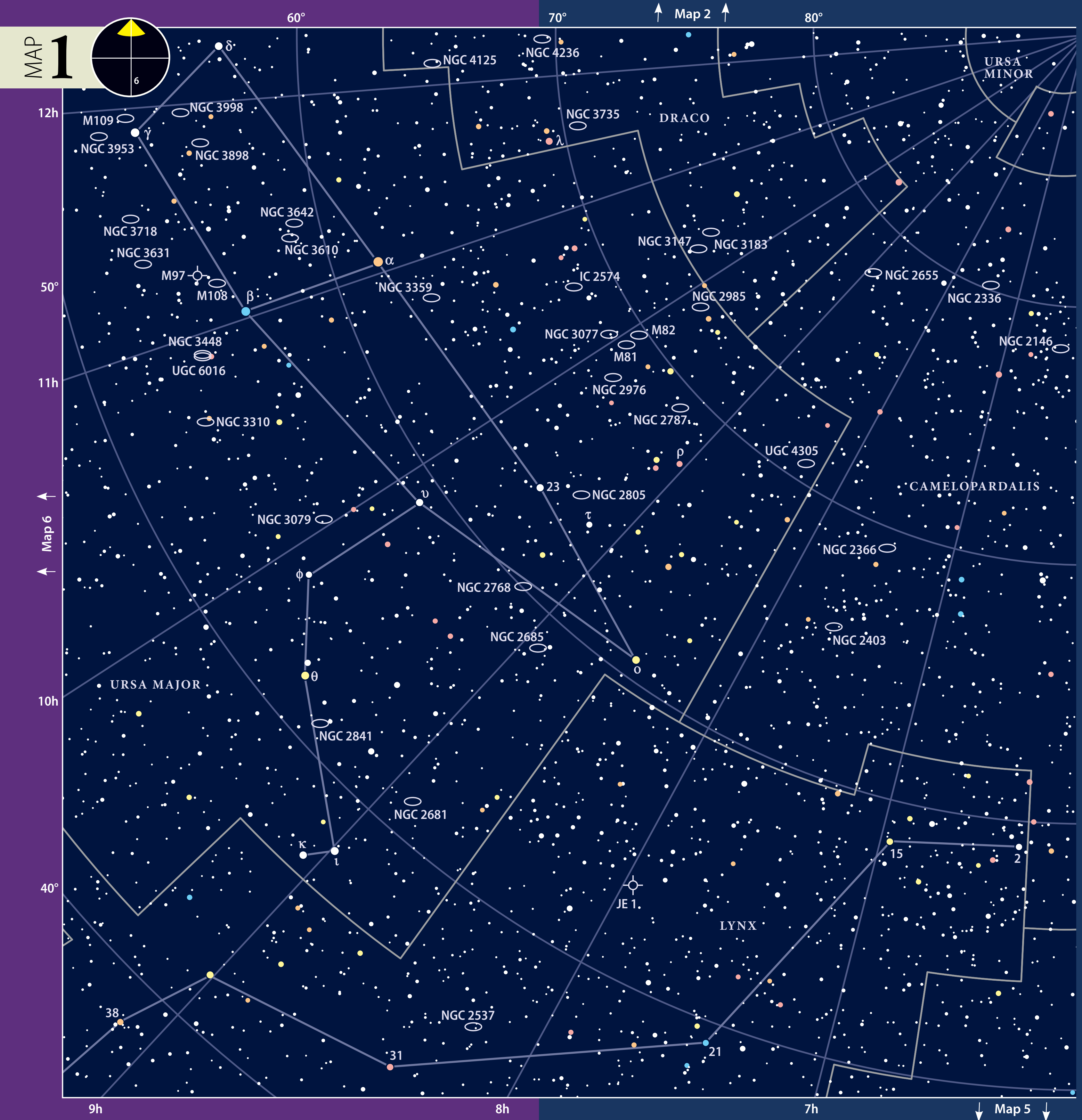
/// DOUBLE-STAR DELIGHTS — MAP 1

Designation	Right ascension	Declination	Magnitudes	Separation
STT 16	0h17m	54°39'	5.7, 10.2	13.3"
Upsilon Cassiopeiae	0h55m	58°58'	5.0, 12.5	14.3"
Psi Cassiopeiae	1h26m	68°07'	4.7, 8.9	25"
49 Cassiopeiae	2h06m	76°06'	5.3, 12.3	5.4"
Iota Cassiopeiae	2h29m	67°02'	4.6, 8.4	7.2"
1 Camelopardalis	4h32m	53°55'	5.7, 6.8	10.3"
3 Camelopardalis	4h40m	53°05'	5.3, 12.3	3.8"
5 Camelopardalis	4h55m	55°15'	5.6, 12.9	12.9"
29 Camelopardalis	5h51m	56°55'	6.5, 9.5	25.1"



KEN AND EMILIE SIARKIEWICZ/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE OWL CLUSTER (NGC 457) — also known as the ET Cluster — in Cassiopeia shines at magnitude 6.4 and is 20' across. Four stars on both the eastern and western edges form the owl's wings.**


MAP 1
6
60°
70°
Map 2
80°
12h
50°
11h
Map 6
10h
40°
9h
8h
7h
Map 5
δ
NGC 4125
NGC 4236
NGC 3998
M109
γ
NGC 3953
NGC 3898
NGC 3735
λ
DRACO
URSA MINOR
NGC 3642
NGC 3718
NGC 3610
NGC 3631
M97
M108
β
α
NGC 3359
IC 2574
NGC 3147
NGC 3183
NGC 2655
NGC 2336
NGC 2985
NGC 3077
M82
M81
NGC 3448
UGC 6016
NGC 2146
NGC 2976
NGC 2787
NGC 3310
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CAMELOPARDALIS
NGC 3079
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NGC 2366
NGC 2768
NGC 2685
NGC 2403
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URSA MAJOR
NGC 2841
NGC 2681
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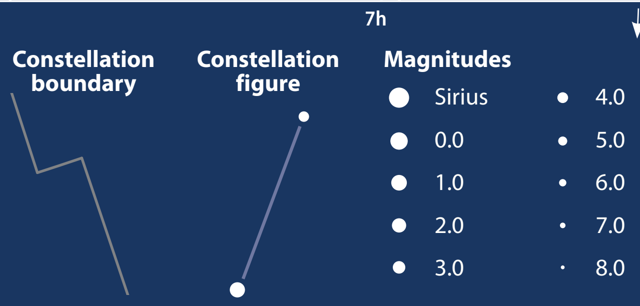
15
2
JE 1
LYNX
38
NGC 2537
31
21

NORTH POLAR 1

From northern latitudes, you'll see this map's area best in the autumn. Most of these objects are invisible to Southern Hemisphere observers.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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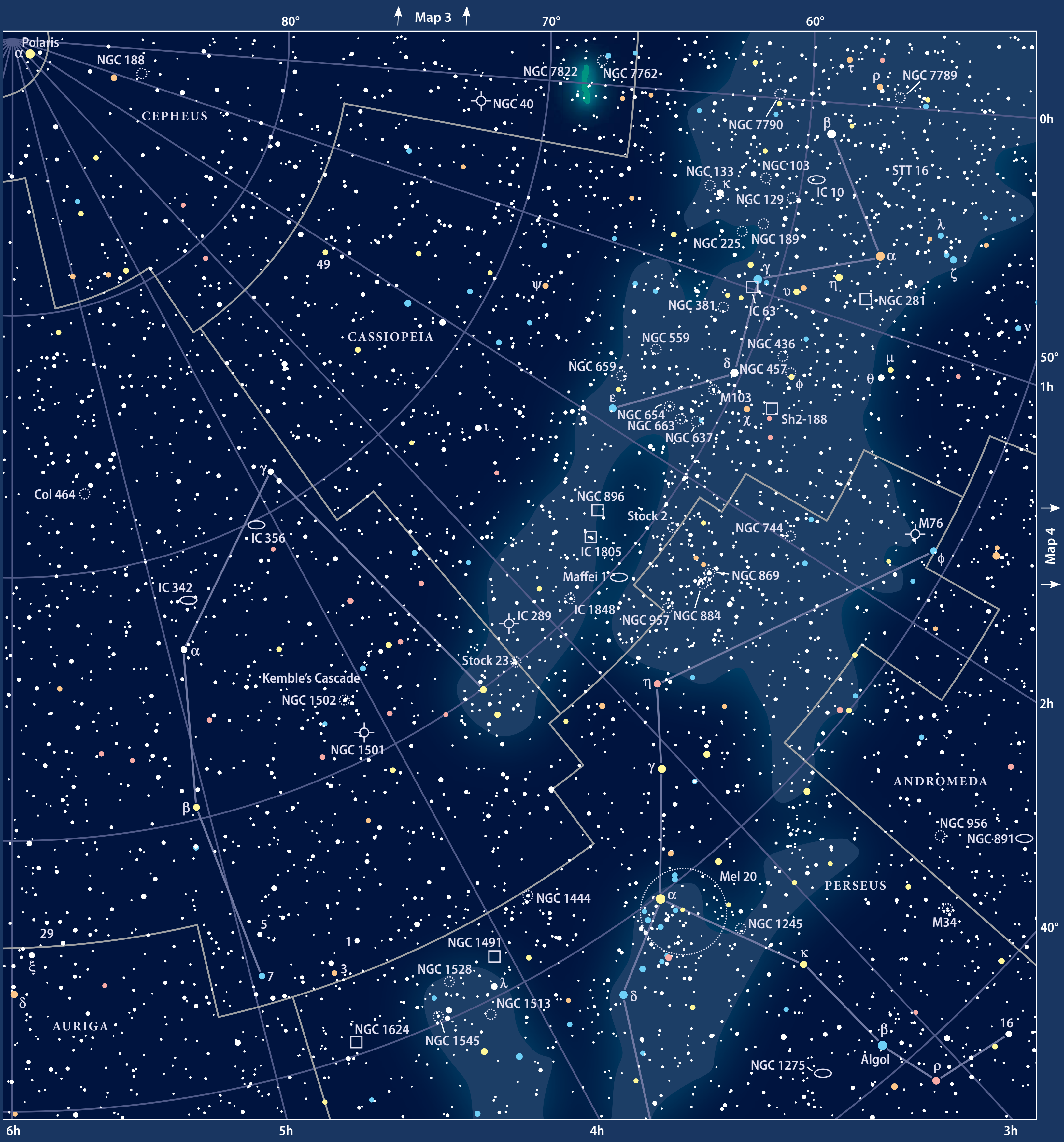
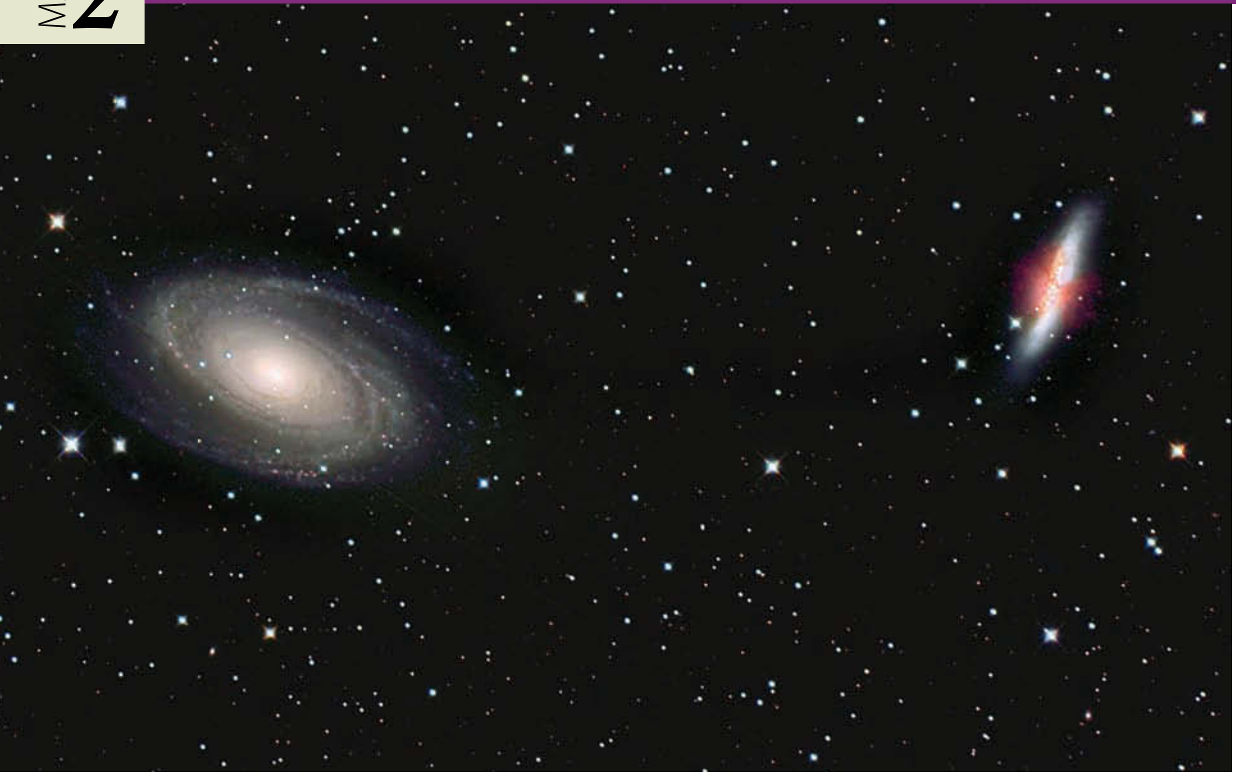
2.0
3.0
4.0
5.0
6.0
7.0
8.0


Map 3
80°
70°
60°
Polaris
α
NGC 188
CEPHEUS
NGC 7822
NGC 7762
NGC 40
NGC 7790
NGC 7789
ρ
τ
β
0h
NGC 133
κ
NGC 103
IC 10
STT 16
NGC 129
NGC 225
NGC 189
λ
49
ψ
γ
α
η
υ
ζ
NGC 381
IC 63
NGC 281
CASSIOPEIA
NGC 559
NGC 436
ν
δ
NGC 457
μ
θ
50°
1h
NGC 659
ε
φ
M103
NGC 654
NGC 663
χ
Sh2-188
NGC 637
ι
γ
Col 464
NGC 896
Stock 2
NGC 744
M76
IC 356
IC 1805
Map 4
φ
IC 342
Maffei 1
NGC 869
IC 1848
IC 289
NGC 957
NGC 884
α
Stock 23
Kemble's Cascade
η
2h
NGC 1502
NGC 1501
γ
β
ANDROMEDA
NGC 956
NGC 891
Mel 20
PERSEUS
NGC 1444
α
29
5
NGC 1245
M34
40°
ξ
1
NGC 1491
κ
7
3
NGC 1528
δ
λ
δ
NGC 1513
AURIGA
16
β
NGC 1624
NGC 1545
NGC 1275
Algol
ρ
6h
5h
4h
3h

- ◌ Open cluster
- ⊕ Globular cluster
- □ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

MAP 2 NORTH POLAR 2



▲ **BODE'S GALAXY** **(M81), left, and the Cigar Galaxy (M82) lie in the northernmost reaches of Ursa Major. Use an eyepiece that provides a wide field of view to see both of these galaxies at once.** RICHARD JACOBS

BRAD EHRHORN/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE SPLINTER GALAXY (NGC 5907) appears 10 times as long as wide because we see it edge-on. Also known as the Knife-edge Galaxy, NGC 5907 lies 40 million light-years away.**

The Bear's realm

The dominant constellation on the next map is Ursa Major the Great Bear. Because this region is far from the Milky Way — where star clusters and nebulae abound — most of the great deep-sky objects here are galaxies. If you don't have a go-to telescope, the seven stars of the Big Dipper can help you find these objects.

Start with the galaxies on Messier's list: **Bode's Galaxy** (M81), the **Cigar Galaxy** (M82), **M101**, **M108**, and **M109**. An eyepiece/telescope combination that provides a field of view wider than ½° will catch both M81 and M82. Higher magnifications will reveal a large core and tight, graceful spiral arms in M81 and a wide, dark lane and splotchy bright areas in M82.

Many large spiral galaxies have up to a dozen nearby galaxies that, with the primary object, form a group. The M81 Group lies 11 million light-years away and counts about a dozen galaxies. To see them, use an 8-inch or larger scope from a dark site. On the other side of M81 from M82 is **NGC 3077**, a 10th-magnitude spiral.

It's worth finding the **Owl Nebula** (M97), a bright planetary nebula in Ursa Major. Under a dark sky, a 4-inch or larger telescope will show the Owl's face, which contains two round, dark areas (the "eyes"). The Owl is a low-surface-brightness object that, except for a bit of a mottled surface, doesn't have a lot of detail.

The most famous double star in the sky lies at the bend of the Big Dipper's handle, and you don't need a telescope to see it. Alcor (80 Ursae Majoris) and Mizar (Zeta Ursae Majoris) once were a vision test for Roman soldiers. Mizar itself, however, is a much closer double star with a separation of only 14".

/// DOUBLE-STAR DELIGHTS — MAP 2

Designation	Right ascension	Declination	Magnitudes	Separation
STT 188	8h22m	74°50'	6.5, 10.5	10.6"
23 Ursae Majoris	9h32m	63°03'	3.8, 9.0	22.8"
STF 1362	9h38m	73°05'	7.2, 7.2	4.7"
Upsilon Ursae Majoris	9h51m	59°03'	3.9, 11.5	11.3"
BU 1424	10h03m	50°07'	7.0, 7.2	28.2"
HJ 2534	10h33m	40°25'	4.8, 11.6	19.3"
Struve 1559	11h39m	64°22'	6.8, 7.8	2.0"
Zeta Ursae Majoris	13h24m	54°55'	2.3, 4.0	14.4"
STF 1774	13h40m	50°30'	6.4, 9.7	17.6"
DL Draconis	14h42m	61°15'	6.3, 8.5	4.1"
STF 1882	14h44m	61°05'	6.8, 8.3	11.6"
STF 1918	15h08m	63°07'	6.8, 10.8	17.8"

◄ **ALTHOUGH M106 SHINES at magnitude 8.4, it is an under-observed galaxy in Messier's catalog because it doesn't show much detail through small scopes. Look for its compact arms from a dark site.** ADRIAN ZSILAVEC AND MICHELLE QUALLS/ADAM BLOCK/NOAO/AURA/NSF

SKY POSITIONS AND COORDINATES

Imagine the sky as a sphere of infinite size centered on Earth. This concept works because distances to celestial objects are not discernible to the eye, so objects appear to lie on a great sphere far away. Astronomers use two coordinate systems.

The alt-azimuth coordinate system

In this system, **altitude** is the number of degrees from the horizon to the object. It ranges from 0° (horizon), to 90° (zenith).

We measure **azimuth** along the horizon from north through east to where a line passing through the object intersects the horizon at a right angle. Azimuth varies between 0° and 360°.

A brief note about angles: A circle contains 360°. Each degree is divided into 60 arcminutes, and each arcminute is divided into 60 arcseconds. The symbol ' designates an arcminute, and " indicates an arcsecond.

The alt-azimuth system's main disadvantage is that objects' coordinates change constantly because of Earth's rotation. We solve this problem by fixing coordinates to the celestial sphere.

The equatorial coordinate system

Imagine projecting Earth's equator and poles to the celestial sphere. This produces the celestial equator as well as the North and South celestial poles.

Declination corresponds to Earth's latitude and is the angle between the object and the celestial equator. It varies from 0° to 90° north or south and is measured in degrees (°), arcminutes ('), and arcseconds ("). A minus sign (–) is used for objects south of the celestial equator.

Circles that run through the celestial poles perpendicular to the celestial equator are hour circles. To designate the position of a star, consider one of these great circles passing through the celestial poles and through a star. This is the star's hour circle, and it corresponds to a meridian of longitude on Earth.

All that's left is to set the zero point of the "longitude" coordinate, which is called **right ascension**. For this, astronomers use the vernal equinox, an intersection point of Earth's equator and its orbital plane, the ecliptic. The Sun appears to move through this point each year around March 21, moving from south to north crossing the celestial equator.

The angle between the vernal equinox and the point where the object's hour circle intersects the celestial equator is the object's right ascension. It is measured in hours (h), minutes (m), and seconds (s). Right ascension is measured from west to east and begins at 0h (the vernal equinox). Each hour corresponds to 15°.

Earth's motions

Earth's rotation has remarkable effects on the sky's appearance: Celestial objects appear to circle the celestial poles. If a star's distance from the pole is greater than your latitude, you won't see the entire circle. Stars simply will rise in the east, move across the sky, and set in the west. If that star is circumpolar for your latitude, you'll see its entire circle.

Earth's revolution around the Sun causes seasonal changes. The effect on the night sky is a slow westward progression of the constellations throughout the year.

For example, if you go out tonight and look at the stars' positions at, let's say, 8 P.M., then tomorrow night, the stars will be in the same position 4 minutes earlier, at 7:56 P.M. The following night, they'll reach that position at 7:52 P.M., and so on. A bit of math reveals that in a month, the stars will be 2 hours out of sync with your first observation.

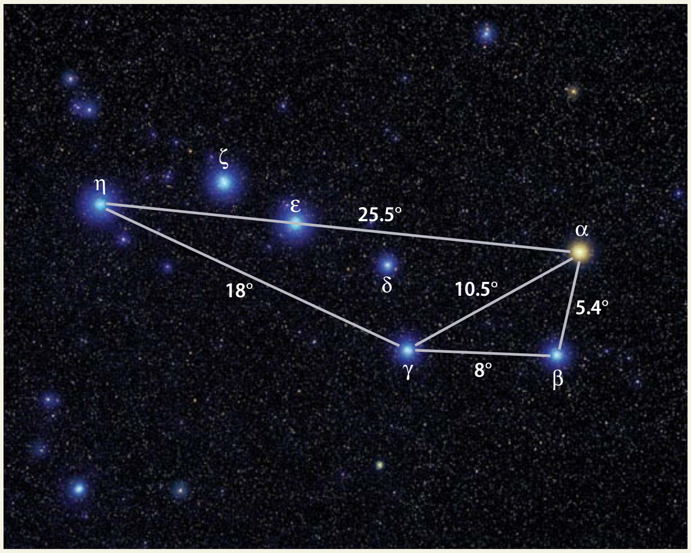
So, if on your first night you saw Gemini the Twins rising low in the east at 8 P.M., a month later, they'll be much higher at that time. And in 3 months — one season — Gemini (and all the other stars) will have moved a quarter of the way across the sky. Four seasons (1 year) later, they'll be back in the position where you first saw them.

ADAM BLOCK/NOAO/AURA/NSF

▲ LIKE A COSMIC propeller, spiral galaxy M101 spins through space. You'll need a big scope to pick out the details of this low-surface-brightness galaxy.

◀ THE OWL NEBULA (M97) resembles the bird after which it's named. This magnitude 9.9 planetary nebula measures 3.3' across.

GARY WHITE AND VERLENNE MONROE/ADAM BLOCK/NOAO/AURA/NSF



BILL AND SALLY FLETCHER

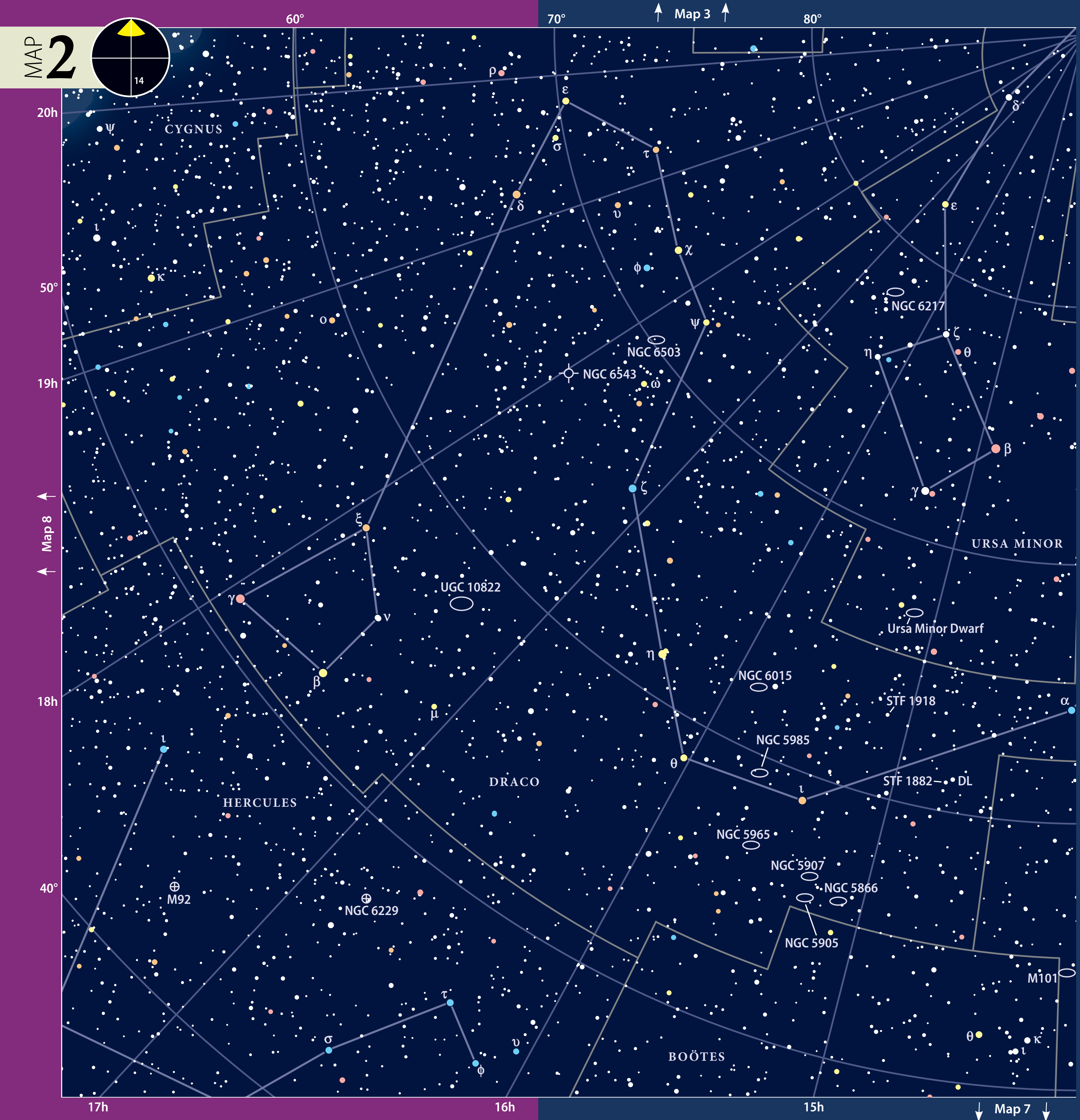
▲ YOU CAN ESTIMATE approximate distances between objects by using star pairs in the Big Dipper as a guide.

"DIPPER" DISTANCES

In this atlas, you'll find objects described as, for example, 12° from such-and-such a star. One way to learn approximate distances is to study the separations among the stars of the Big Dipper.

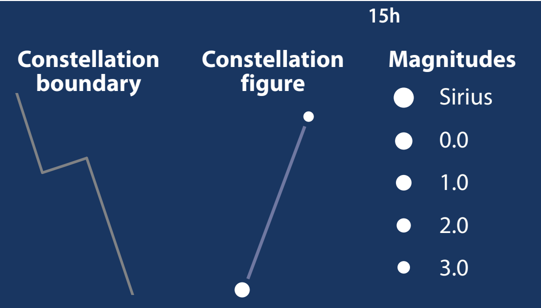
Alpha Ursae Majoris lies approximately 5° from Beta Ursae Majoris. Delta is 10° from Beta, which lies 25° from Eta, and so on.

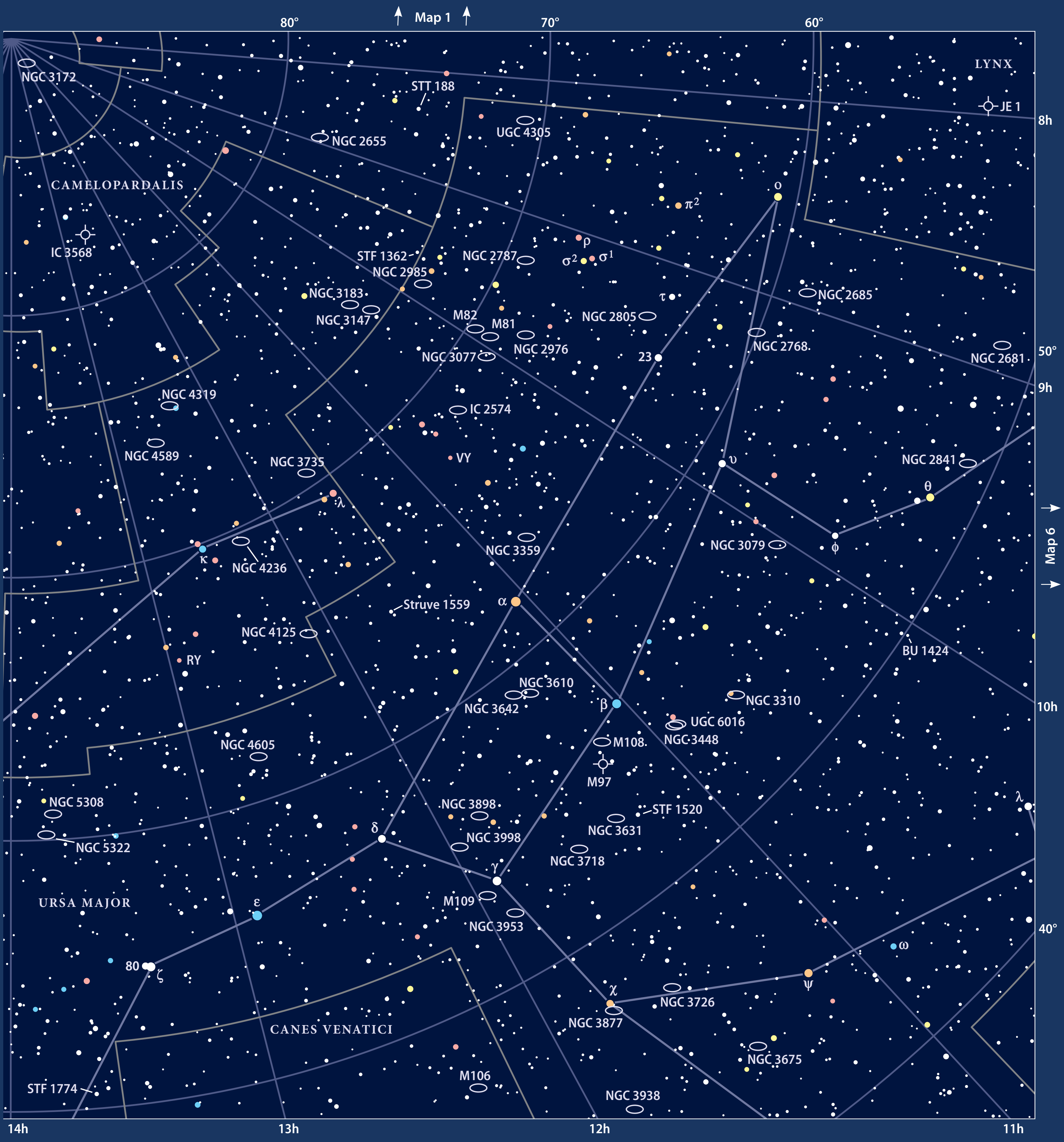
You can learn to estimate distances less than 1° also. The Full Moon measures ½° across, the same distance between the two stars in Scorpius' stinger. In the Pleiades (Map 5), Maia (20 Tauri) and Celaeno (16 Tauri) lie ¼° apart. Maia and Taygeta (19 Tauri) are 10' apart, and Atlas (27 Tauri) and Pleione (28 Tauri) lie 5' apart.


MAP 2
14
60°
70°
Map 3
80°
20h
50°
19h
Map 8
18h
40°
17h
16h
15h
Map 7
CYGNUS
URSA MINOR
DRACO
HERCULES
BOÖTES
ψ
ρ
ε
σ
τ
δ
υ
ι
χ
φ
κ
ο
ψ
NGC 6503
NGC 6543
ω
NGC 6217
ε
ζ
η
θ
β
γ
ζ
ξ
γ
ν
β
UGC 10822
Ursa Minor Dwarf
η
NGC 6015
STF 1918
α
μ
NGC 5985
θ
ι
STF 1882
DL
ι
NGC 5965
NGC 5907
NGC 5866
M92
NGC 6229
NGC 5905
M101
τ
σ
υ
φ
θ
κ
ι

NORTH POLAR 2

In the Northern Hemisphere, use this map during the early evening in late winter and early spring, or anytime of the year if your latitude lies above 50°.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


Map 1
80°
70°
60°
8h
50°
9h
10h
40°
Map 6
14h
13h
12h
11h
LYNX
CAMELOPARDALIS
URSA MAJOR
CANES VENATICI
JE 1
NGC 3172
STT 188
UGC 4305
NGC 2655
IC 3568
STF 1362
NGC 2985
NGC 2787
ρ
σ2
σ1
π2
ο
τ
NGC 3183
NGC 3147
M82
M81
NGC 2805
NGC 2685
NGC 2976
NGC 3077
23
NGC 2768
NGC 2681
NGC 4319
IC 2574
NGC 4589
NGC 3735
VY
υ
NGC 2841
θ
λ
κ
NGC 4236
NGC 3359
NGC 3079
φ
Struve 1559
α
NGC 4125
BU 1424
RY
NGC 3610
NGC 3642
β
NGC 3310
UGC 6016
NGC 3448
M108
M97
NGC 4605
NGC 5308
NGC 3898
STF 1520
NGC 3631
λ
NGC 5322
δ
NGC 3998
NGC 3718
γ
ε
M109
NGC 3953
ω
80
ζ
χ
NGC 3726
ψ
NGC 3877
NGC 3675
M106
STF 1774
NGC 3938

◌ Open cluster

⊕ Globular cluster

□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

ADAM BLOCK/NOAO/AURA/NSF

▲ **NGC 6503 IN DRACO** **is a lens-shaped spiral galaxy with compact arms. The star less than 4' east (left) of NGC 6503 is magnitude 8.6 SAO 8937.**

Celestial sampler

Cepheus the King and part of the huge constellation Draco the Dragon make up most of Map 3. This area of sky may not contain many bright stars, but it offers a variety of celestial targets, from red stars to galaxies.

Start your deep-sky hunt 5° east of Zeta Draconis with the **Cat's Eye Nebula** (NGC 6543). Depending on your color perception, you'll either see this planetary nebula as greenish-blue or bluish-green, but you will see color. Through a 10-inch scope, the Cat's Eye resembles a somewhat unstructured spiral galaxy. An outer shell of gas 5' across surrounds the "eye," but seeing this feature requires a 16-inch or larger telescope.

Only 1.8° northeast of Omega Draconis lies **NGC 6503**, a magnitude 10.1 spiral galaxy that even a 4-inch scope will reveal. NGC 6503 is roughly 3 times as long as it is wide. Its central region appears elongated, but the brightest part does not sit over NGC 6503's center.

In Cepheus, you'll find open cluster **NGC 6939** easily. It forms an equilateral triangle with 3rd-magnitude Eta and 4th-magnitude Theta Cephei. NGC 6939 is a magnitude 7.8 group of roughly 60 stars between magnitudes 11 and 13 in an area 5' across.

Along Cepheus' southern edge lies **Herschel's Garnet Star** (Mu Cephei). Astronomer William Herschel first described it in the 18th century. Glowing at 4th magnitude, Mu is one of the sky's reddest stars — a sure cure for the observing blues.

Mu marks the northern edge of emission nebula **IC 1396**. This giant object spans 2° (4 Full Moons) and is difficult to see through 6-inch or smaller telescopes. Through larger instruments, IC 1396 appears as a circular mist crossed by many dark lanes.

THE MAGNITUDE SYSTEM

In the second century B.C., Greek astronomer Hipparchus of Rhodes cataloged a list of 850 stars into six brightness ranges, or magnitudes. The brightest he called 1st-magnitude stars and the faintest 6th magnitude. Skywatchers used his system for 1,800 years.

Then, Italian astronomer Galileo Galilei noted his telescope revealed otherwise invisible objects. Galileo coined the term "7th magnitude stars."

The invention of the telescope expanded the magnitude system. In the 18th century, a loose system defined two stars differing by 1 magnitude as having a brightness difference of 2.5 times.

In 1856, English astronomer Norman Pogson suggested a constant to calibrate all magnitudes. He changed the ratio between magnitudes from 2.5 to 2.5118865. This number, multiplied by itself 5 times, equals 100. So Sirius (Alpha Canis Majoris) at magnitude –1.47 is 100 times as bright as Wasat (Delta Geminorum) at magnitude 3.54, which is 5 magnitudes fainter.

Nineteenth-century astronomers noticed some stars are brighter than magnitude 1. The bright planets, the Moon, and the Sun are even brighter. So they defined magnitudes equal to and less than zero.

How bright a celestial object appears from Earth is its apparent magnitude (m). There's also a standardized magnitude — absolute magnitude (M) — that allows astronomers to compare the real brightnesses of objects. Absolute magnitude is the brightness a celestial object would have if its distance were 32.6 light-years (10 parsecs) from Earth.

Estimating limiting magnitude

While you're observing, it's a good idea to estimate limiting visual magnitude. This helps determine how good the conditions are and assigns a number value. Such an estimate also allows you to judge the quality of your observations months or years after that session. Most amateurs take a limiting-magnitude estimate near the zenith (the overhead point), where lights on the horizon are least obvious and there is less atmosphere to look through.

Another option is to make a limiting-magnitude estimate using the stars near Polaris (Alpha Ursae Minoris). Also, you can estimate telescopic limiting magnitude: Insert a medium-power (approximately 100x) eyepiece into your scope. Point your scope near, but not at, your target object. Sketch all visible stars in the area. Later, compare your drawing with a star chart or your computer monitor, if you use sky-plotting software.

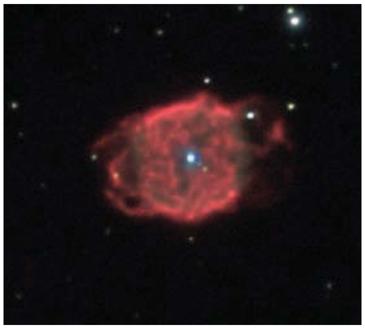
ADAM BLOCK/NOAO/AURA/NSF

▲ **THE ELEPHANT TRUNK NEBULA** **(van den Bergh 142) is a dark nebula that is part of the much larger IC 1396 nebula complex.**

FRED CALVERT/ADAM BLOCK/NOAO/AURA/NSF

▲ **NGC 7538** lies 43' west-northwest of the larger and fainter Bubble Nebula (NGC 7635). An Oxygen-III filter will help you observe this object.

▶ **THE BUBBLE NEBULA** (NGC 7635) floats about 0.6° southwest of the bright star cluster M52. NGC 7635 glows because of an energetic star at its center. BRAD EHRHORN/ADAM BLOCK/NOAO/AURA/NSF



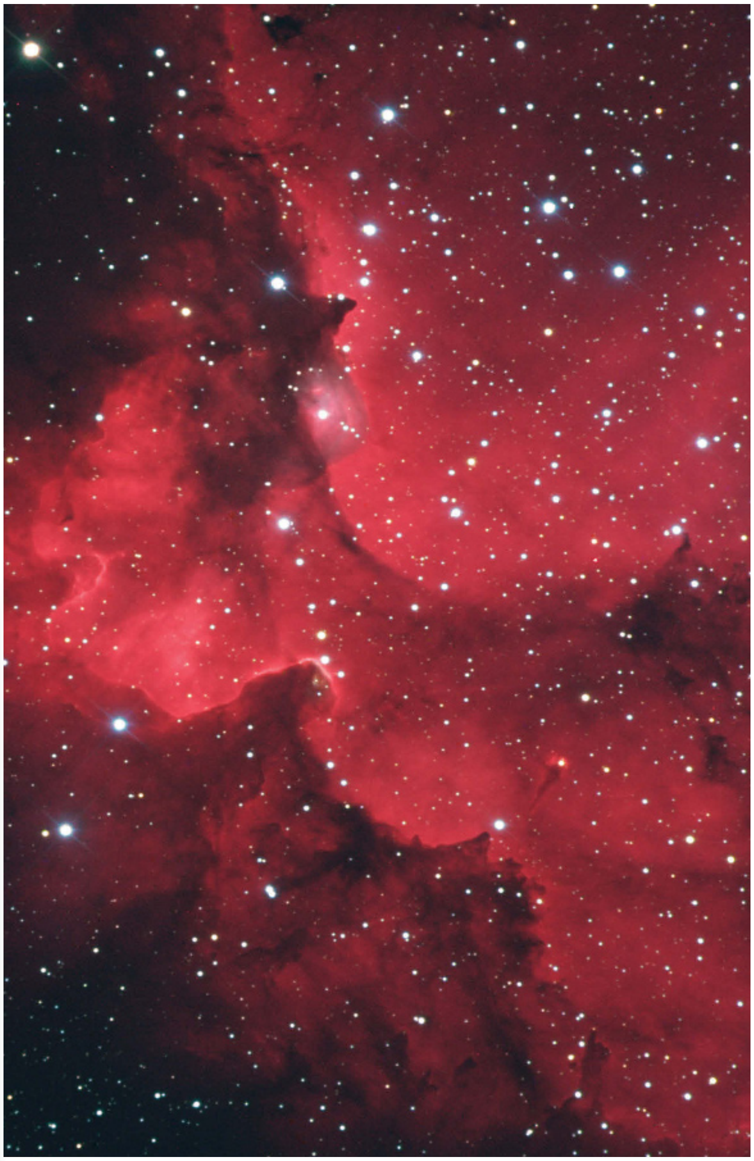
▲ **THE BOW-TIE NEBULA** (NGC 40) doesn't give up its secrets easily. Use an 8-inch or larger telescope from a dark site, and you'll note NGC 40's reddish hue. STEVE AND PAUL MANDEL/ADAM BLOCK/NOAO/AURA/NSF

ADAM BLOCK/NOAO/AURA/NSF

▲ **THE EYE IN THE SKY** in this case is the Cat's Eye Nebula (NGC 6543) in Draco. You can observe this magnitude 8.1 planetary nebula through any size telescope. NGC 6543 measures 20" across.

/// DOUBLE-STAR DELIGHTS — MAP 3

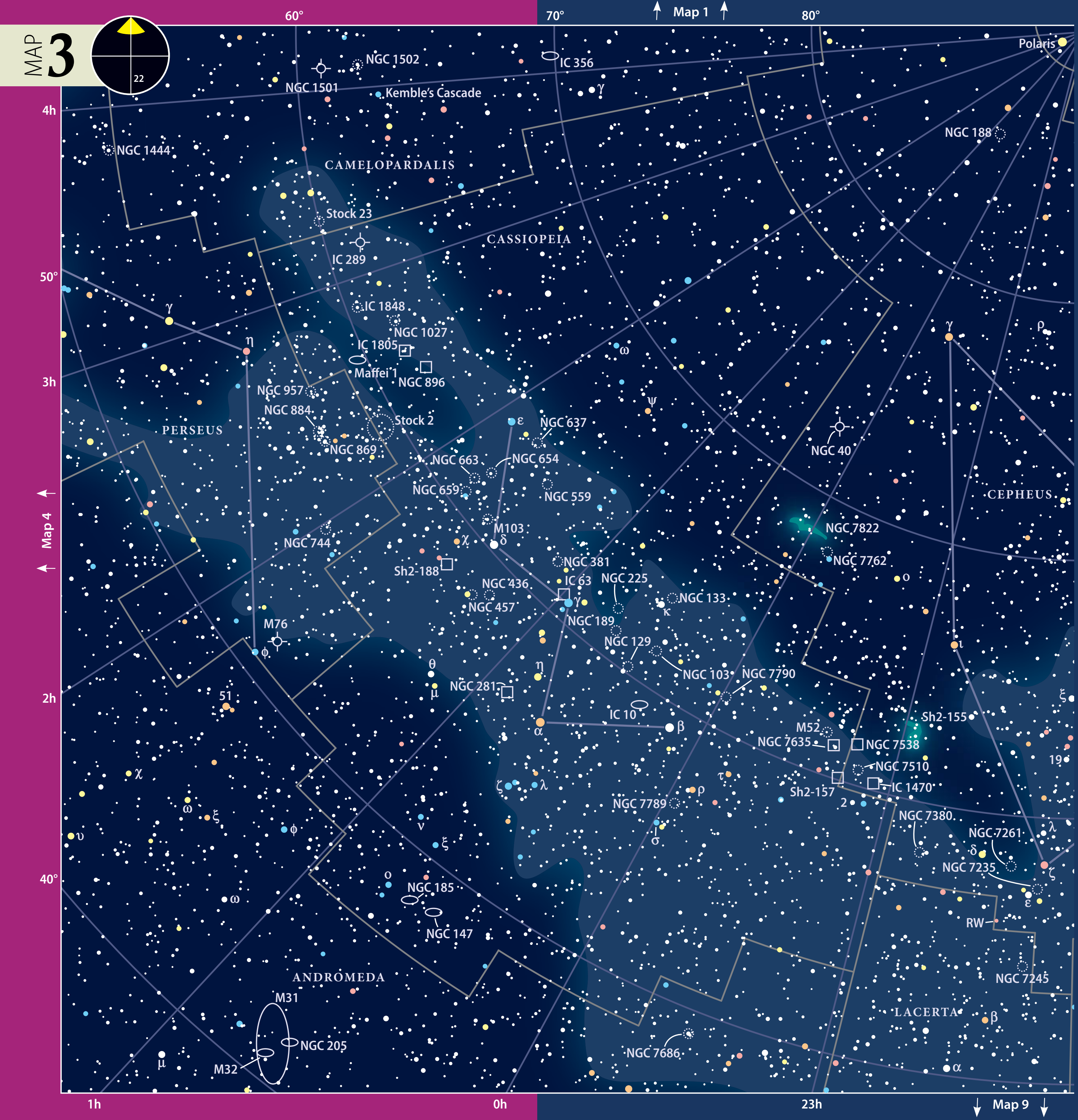
Designation	Right ascension	Declination	Magnitudes	Separation
Eta Draconis	16h24m	61°30'	2.9, 8.9	5.2"
17 Draconis	16h36m	52°55'	5.6, 6.6	3.2"
41 Draconis	18h00m	79°59'	5.8, 6.2	19.1"
39 Draconis	18h24m	58°48'	4.9, 7.9	3.8"
Epsilon Draconis	19h48m	70°16'	4.0, 7.6	3.1"
65 Draconis	20h02m	64°37'	6.2, 10.1	5.6"
Kappa Cephei	20h09m	77°43'	4.4, 8.4	7.3"
Beta Cephei	21h29m	70°03'	3.3, 8.0	13.4"
Xi Cephei	22h04m	64°37'	4.4, 6.5	7.7"
19 Cephei	22h05m	62°17'	5.2, 11.2	19.8"
2 Cassiopeiae	23h10m	59°19'	5.6, 13.0	19.9"
Omicron Cephei	23h19m	68°06'	5.0, 7.6	3.2"
Sigma Cassiopeiae	23h59m	55°45'	5.0, 7.1	3.1"



KRIS SANDBURG AND PETER JACOBS/ADAM BLOCK/NOAO/AURA/NSF

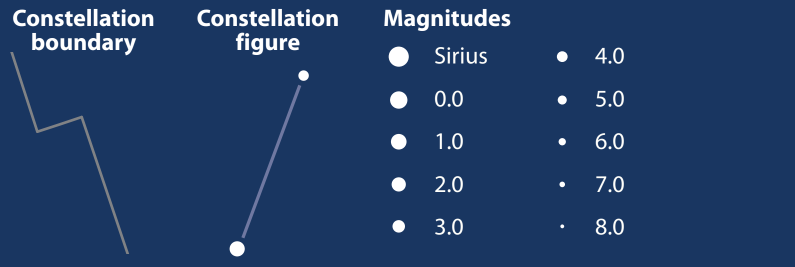
▲ **OPEN CLUSTER NGC 7380** makes up one part of this fascinating sky region. The remainder is the bright emission nebula Sharpless 2–142.

MAP 3


22
60°
70°
Map 1
80°
Polaris
NGC 1502
NGC 1501
IC 356
γ
Kemble's Cascade
4h
NGC 1444
NGC 188
CAMELOPARDALIS
Stock 23
IC 289
CASSIOPEIA
50°
γ
IC 1848
η
NGC 1027
IC 1805
Maffei 1
NGC 896
ω
γ
ρ
3h
NGC 957
NGC 884
PERSEUS
Stock 2
NGC 869
ε
NGC 637
ψ
NGC 40
NGC 663
NGC 654
NGC 659
NGC 559
CEPHEUS
Map 4
M103
χ
δ
NGC 744
NGC 7822
NGC 7762
o
NGC 381
Sh2-188
IC 63
NGC 225
NGC 436
γ
NGC 133
κ
NGC 457
NGC 189
M76
φ
NGC 129
ι
θ
η
NGC 103
NGC 7790
NGC 281
μ
2h
51
IC 10
ξ
α
β
Sh2-155
M52
NGC 7635
NGC 7538
NGC 7510
19
χ
ζ
λ
τ
IC 1470
ρ
Sh2-157
2
NGC 7789
ω
ξ
φ
υ
ν
σ
ξ
NGC 7380
NGC 7261
λ
δ
NGC 7235
ζ
40°
o
NGC 185
ω
ε
NGC 147
RW
NGC 7245
ANDROMEDA
M31
LACERTA
β
NGC 205
NGC 7686
μ
M32
α
1h
0h
23h
Map 9

NORTH POLAR 3

In the Northern Hemisphere, use this map during the early evening in mid-autumn, or any time of the year if your latitude lies above 50°.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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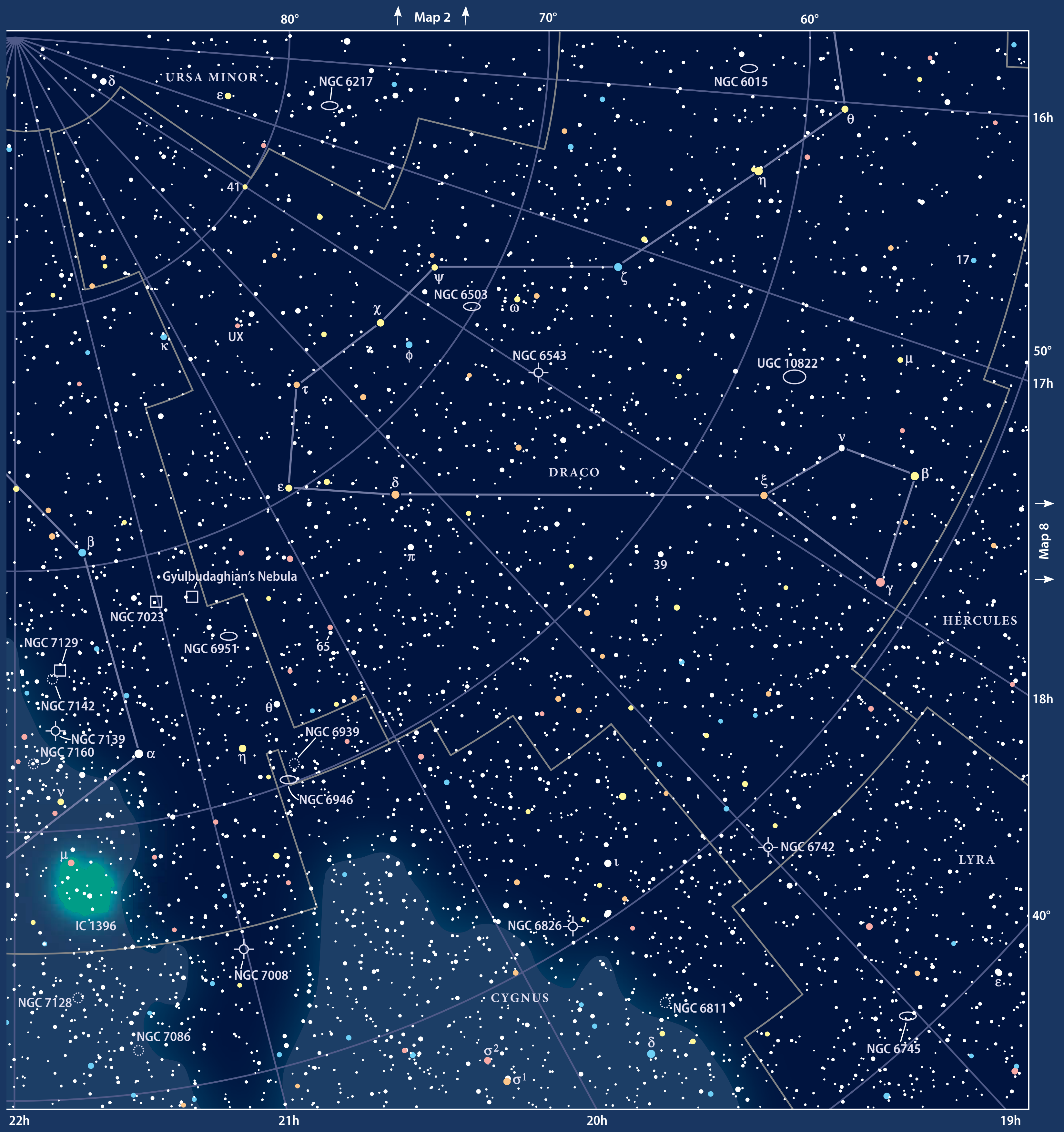
2.0
3.0
4.0
5.0
6.0
7.0
8.0


80°
Map 2
70°
60°
16h
50°
17h
18h
40°
19h
20h
21h
22h
Map 8
URSA MINOR
δ
ε
NGC 6217
NGC 6015
θ
η
41
ψ
ζ
NGC 6503
ω
χ
17
UX
κ
φ
NGC 6543
UGC 10822
μ
τ
ν
DRACO
ε
δ
ξ
β
β
π
39
γ
Gyulbudaghian's Nebula
NGC 7023
HERCULES
NGC 6951
65
NGC 7129
NGC 7142
θ
NGC 7139
NGC 6939
NGC 7160
α
η
ν
NGC 6946
NGC 6742
μ
ι
LYRA
IC 1396
NGC 6826
NGC 7008
ε
CYGNUS
NGC 7128
NGC 6811
NGC 7086
δ
NGC 6745
σ2
σ1

◌ Open cluster

⊕ Globular cluster

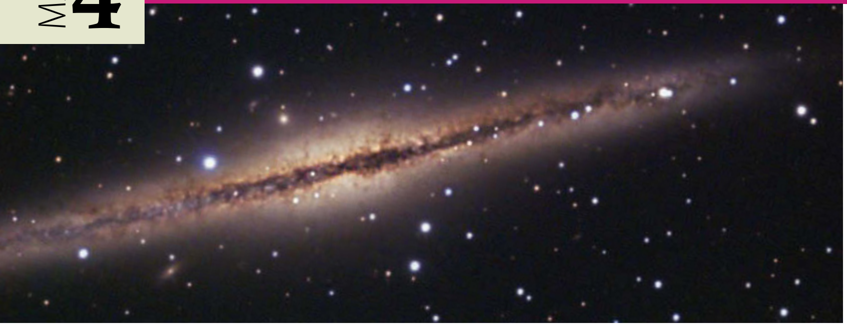
□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

MAP 4 NORTH EQUATORIAL 1


BRIAN LULA

▲ **SPIRAL GALAXY NGC 891 in Andromeda appears nearly edge-on from our vantage point. Through an 8-inch or larger telescope, you'll see the thin dust lane that bisects NGC 891 lengthwise.**

The Princess' sky

The next map features two large constellations, Andromeda the Princess and Perseus the Hero, and two small ones, Triangulum the Triangle and Aries the Ram. All four have bright sections that make them easy to find.

Andromeda contains the ultimate northern deep-sky object: the **Andromeda Galaxy** (M31). Find it 1° west of Nu Andromedae. Visible to the naked eye even from moderately bright locations, M31 measures more than 3° long — or 6 Full Moons side by side.

The Andromeda Galaxy is a showpiece through any telescope. Small scopes with eyepieces that give a wide field of view let you study the galaxy's overall structure. Move up to a 6-inch scope at a dark site, and you'll see two dust lanes. Larger telescopes allow you to crank up the magnification and study individual features.

M31's two bright companions, **M32** and **NGC 205**, are small elliptical galaxies. Such objects normally appear featureless, and you'll notice this a lot more because of their positions near M31.

If you can tear your gaze from the Andromeda Galaxy, your reward will be a colorful sight in Andromeda: the **Blue Snowball** (NGC 7662), a planetary nebula lying 3,000 light-years away from Earth. Low-power views bring out NGC 7662's color best. More magnification reveals rich structure. A hollow region surrounds the 13th-magnitude central star.

Take a good look at Gamma Andromedae, a blue-and-orange double star, then move 3½° east to the spiral galaxy **NGC 891**. Veering only 1.4° from being exactly edge-on, NGC 891 is 4 times as long as it is wide, has a large, bright nucleus, and splits lengthwise because of a dark dust lane. Point a 10-inch or larger scope at NGC 891, and you'll see why it makes so many "top 10" lists of best-to-observe galaxies.

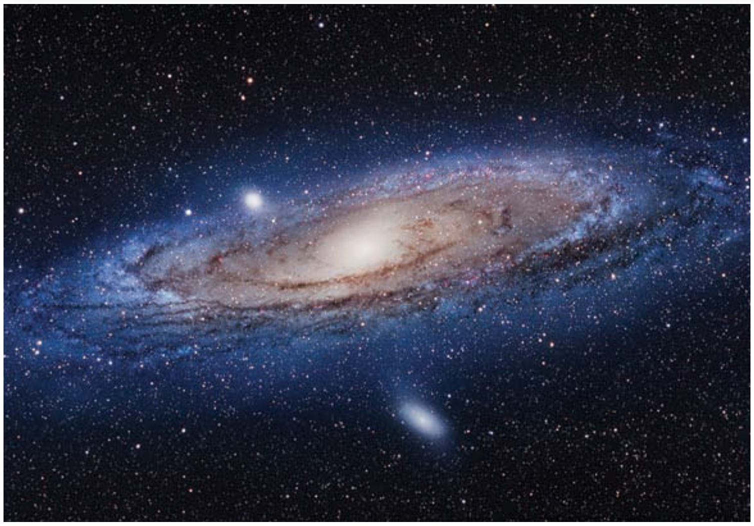
If you're observing from a light-polluted site, point your telescope 4.3° west of magnitude 3.4 Alpha Trianguli to find the **Pinwheel Galaxy** (M33). From a dark site, no such directions are required because M33 is visible to the naked eye.

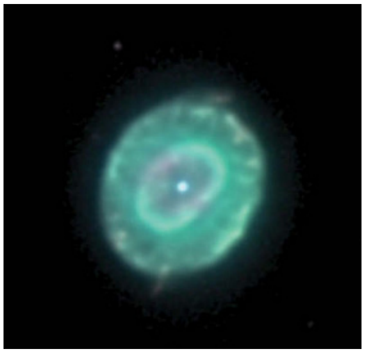
Through a telescope, M33 explodes into detail, with multiple spiral arms, bright stellar associations, and — through a 12-inch or larger telescope — the emission nebula NGC 604. This object sits at the tip of M33's northern spiral arm. A nebula filter will highlight NGC 604.

At the map's eastern edge lies the **Pleiades** (M45), a naked-eye star cluster, and, at magnitude 1.5, the brightest object in Messier's catalog. As you scan M45, let your telescopic gaze fall on Merope (23 Tauri). Surrounding this star is the Merope Nebula (NGC 1435), a cloud of gas passing through M45 and lit by its bright stars. NGC 1435 doesn't respond to nebula filters because it's a reflection nebula.

/// DOUBLE-STAR DELIGHTS — MAP 4

Designation	Right ascension	Declination	Magnitudes	Separation
Delta Andromedae	0h39m	30°52'	3.5, 13.0	28.7"
39 Andromedae	1h03m	41°20'	5.9, 12.3	20.1"
Gamma Arietis	1h54m	19°17'	4.8, 4.8	7.8"
Epsilon Trianguli	2h03m	33°16'	5.4, 11.4	4.0"
Gamma Andromedae	2h04m	42°20'	2.3, 5.5	9.8"
59 Andromedae	2h11m	39°02'	6.0, 6.7	16.7"
6 Trianguli	2h12m	30°18'	5.2, 6.6	3.9"
33 Arietis	2h41m	27°03'	5.5, 8.4	28.6"
Theta Persei	2h44m	49°13'	4.2, 10.0	19.7"
Pi Arietis	2h49m	17°28'	5.3, 8.8	3.2"
41 Arietis	2h50m	27°15'	3.7, 10.8	24.6"
20 Persei	2h54m	38°20'	5.3, 10.0	15.0"
STF 401	3h31m	27°33'	6.6, 6.9	11.1"
Sigma Persei	3h31m	47°51'	4.4, 6.2	22.9"
STF 431	3h42m	33°57'	5.0, 10.0	20.0"
Zeta Persei	3h54m	31°52'	2.9, 9.5	12.8"
Struve 469	3h57m	41°52'	6.8, 10.3	8.9"
Epsilon Persei	3h58m	40°00'	3.0, 8.2	8.8"
Mu Persei	4h15m	48°24'	4.3, 11.8	14.8"


TONY HALLAS



▲ **THE ANDROMEDA GALAXY (M31) is one of the showpiece deep-sky objects. Whatever size telescope (or binoculars) you use, this object will reward you for the time you spend observing it.**

◀ **THE BLUE SNOWBALL (NGC 7662) is a planetary nebula in Andromeda. Its name is well-earned. Use 50x to 100x to bring out the color.** ADAM BLOCK/NOAO/AURA/NSF

CONSTELLATIONS, PART 1

All stars are grouped into constellations — 88 of these patterns cover the sky. There's no overlap among constellations, and no gaps lie between them. The International Astronomical Union made the constellation boundaries official in 1928. Today, when we talk about celestial objects being "in" a particular constellation, this means you'll find the object within that star group's official boundaries.

Constellation	Abbreviation	Pronunciation	Best seen	Map
Andromeda	And	an drah' meh dah	early Oct.	4
Antlia	Ant	ant' lee ah	late Feb.	18
Apus	Aps	ape' us	late May	23
Aquarius	Aqr	ah qwayr' ee us	late Aug.	15
Aquila	Aql	ak' wi lah	mid-July	14
Ara	Ara	air' ah	early June	24
Aries	Ari	air' eeze	late Oct.	10
Auriga	Aur	or eye' gah	late Dec.	5
Boötes	Boo	bow owe' teez	early May	7
Caelum	Cae	see' lum	early Dec.	17
Camelopardalis	Cam	kam uh low par' dah lis	late Dec.	1
Cancer	Can	kan' sir	late Jan.	6
Canes Venatici	CVn	kay' neez ven ah tee' see	early April	7
Canis Major	CMa	kay' nis may' jor	early Jan.	17
Canis Minor	CMi	kay' nis my' nor	mid-Jan.	11
Capricornus	Cap	kap ri kor' nus	early Aug.	21
Carina	Car	kah ree' nah	late Jan.	22
Cassiopeia	Cas	kass ee oh pee' uh	early Oct.	1
Centaurus	Cen	sen tor' us	late May	19
Cepheus	Cep	see' fee us	late Sept.	3
Cetus	Cet	see' tus	mid-Oct.	10
Chamaeleon	Cha	kah meel' ee an	early March	23
Circinus	Cir	sir sin' us	late April	23
Columba	Col	kol um' bah	mid-Dec.	17
Coma Berenices	Com	koe' mah bear uh nye' seez	early April	7
Corona Australis	CrA	kor oh' nah os tral' iss	late June	20
Corona Borealis	CrB	kor oh' nuh boar ee al' iss	mid-May	7
Corvus	Crv	kor' vus	late March	19
Crater	Crt	kray' ter	mid-March	12
Crux	Cru	kruks	late March	23
Cygnus	Cyg	sig' nus	late July	9
Delphinus	Del	del fee' nus	late July	15
Dorado	Dor	dor ah' doh	mid-Dec.	22
Draco	Dra	dray' koh	late May	2
Equuleus	Equ	ek woo oo' lee us	early Aug.	15
Eridanus	Eri	air uh day' nus	early Nov.	16
Fornax	For	for' nax	early Nov.	16
Gemini	Gem	gem' in eye	early Jan.	5
Grus	Gru	groose	late Aug.	21
Hercules	Her	her' cue leez	mid-Jan.	8
Horologium	Hor	hor uh low' gee um	early Nov.	22
Hydra	Hya	hi' drah	mid-March	12
Hydrus	Hyi	hi' drus	late Oct.	22
Indus	Ind	in' dus	mid-Aug.	24

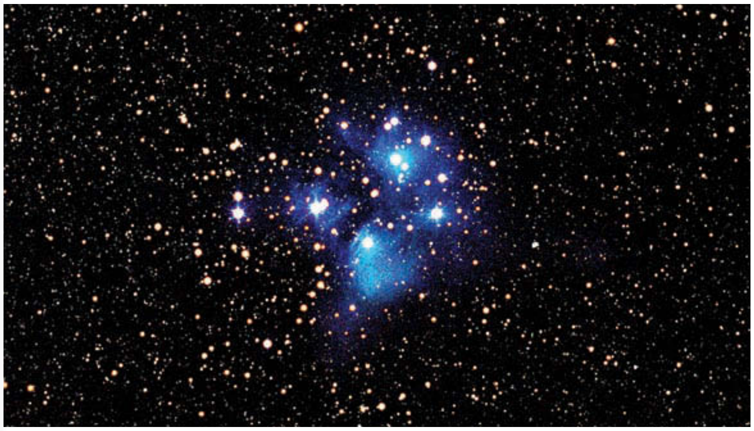
Note: The "Best seen" column gives the midnight culmination dates for the constellations' central points. These dates indicate when a constellation lies opposite the Sun and is highest at midnight. "Map" indicates where a constellation's central point (in R.A. and Dec.) lies.

Continued on page 20

GERALD RHEMANN AND MICHAEL JÄGER

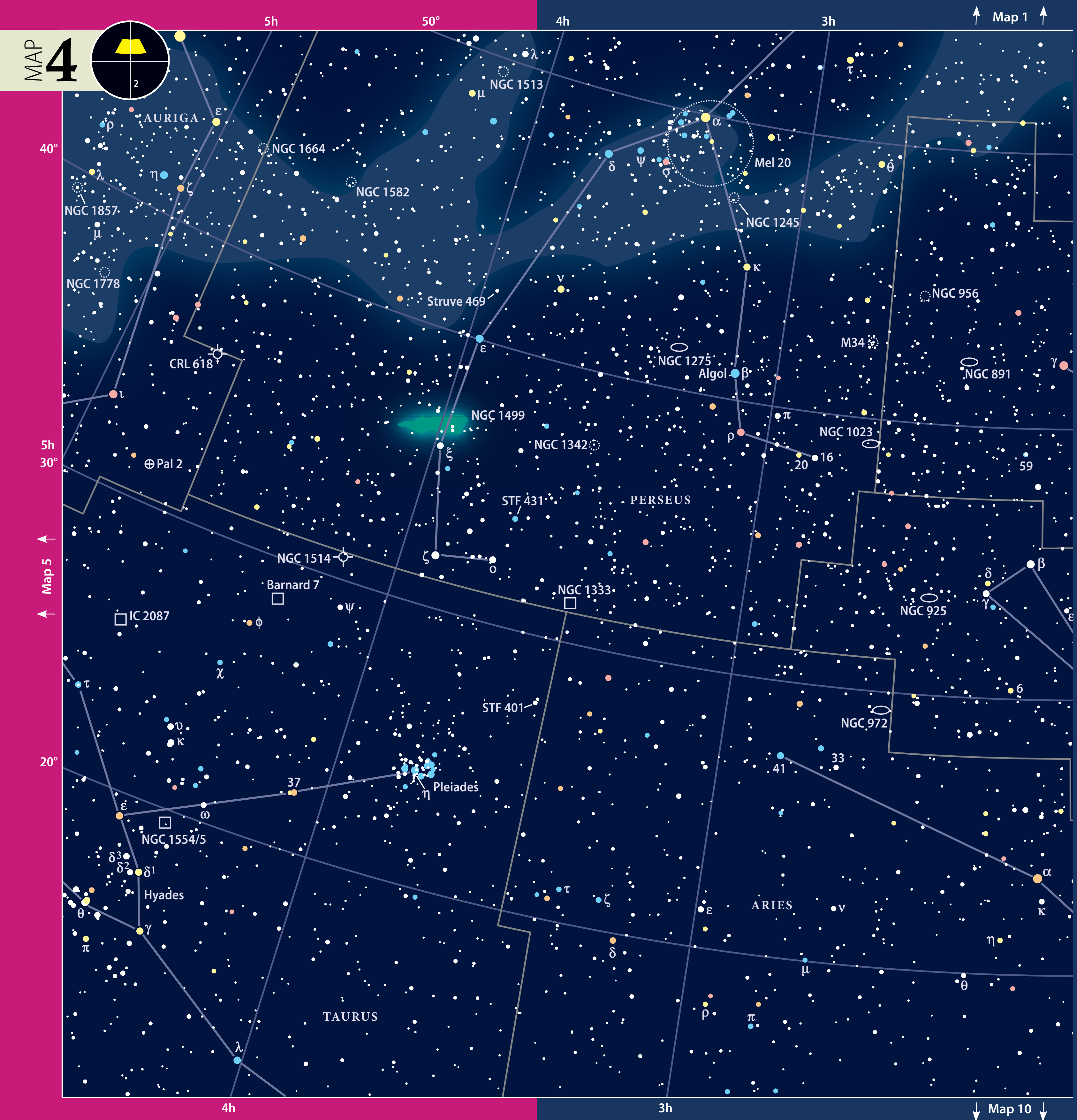
▲ **THE PINWHEEL GALAXY** (M33) lies in Triangulum and is more difficult to observe than its magnitude 5.7 brightness indicates. Because it faces us, M33's light spreads out over an area 73' by 45'.

▲ **THE CALIFORNIA NEBULA** (NGC 1499) in Perseus looks much better in photographs than it does to the eye because of its low surface brightness. A Hydrogen-beta filter increases the contrast. ADAM BLOCK/NOAO/AURA/NSF



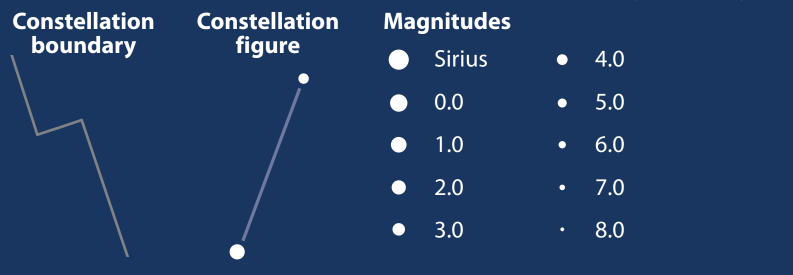
CHRIS SCHUR

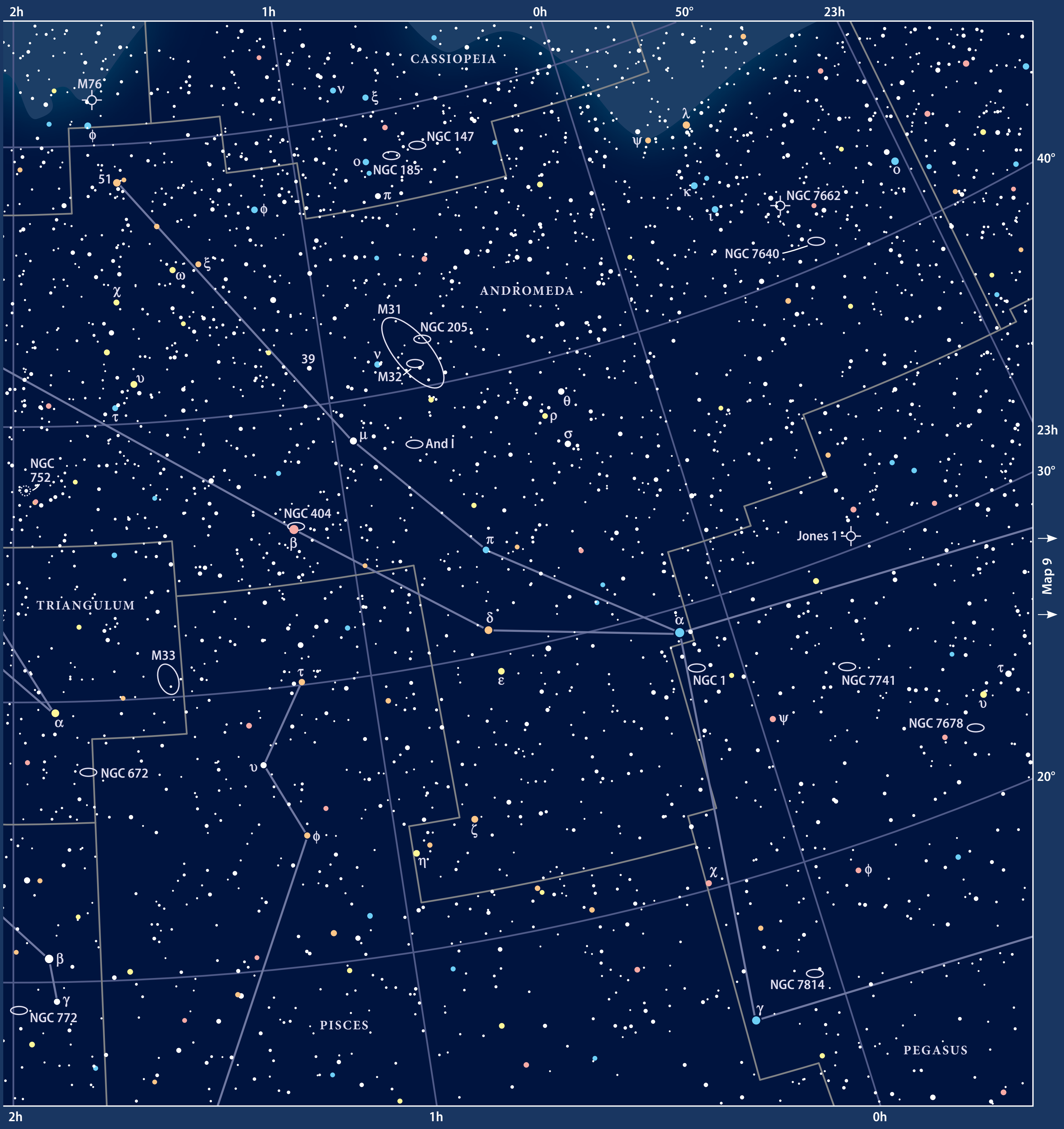
▲ **THE PLEIADES** (M45) is one of the closest star clusters. Some observers test their eyesight by counting Pleiads. How many can you see?


MAP 4
2
5h
50°
4h
3h
Map 1
40°
5h
30°
Map 5
20°
4h
3h
Map 10
AURIGA
ρ
λ
η
ε
ζ
NGC 1857
μ
NGC 1778
NGC 1664
NGC 1582
NGC 1513
μ
λ
α
ι
δ
ψ
φ
Mel 20
NGC 1245
κ
θ
τ
ν
Struve 469
ε
CRL 618
ι
NGC 956
M34
NGC 1275
Algol
β
γ
NGC 891
NGC 1499
π
ρ
NGC 1342
NGC 1023
16
20
59
ξ
Pal 2
STF 431
PERSEUS
ζ
ο
NGC 1514
Barnard 7
ψ
IC 2087
φ
NGC 1333
δ
β
γ
NGC 925
ε
χ
τ
6
STF 401
NGC 972
υ
κ
33
41
37
Pleiades
η
ε
ω
NGC 1554/5
δ3
δ2
δ1
Hyades
θ
γ
π
τ
ζ
ε
ARIES
ν
α
κ
η
δ
μ
θ
TAURUS
ρ
π
λ

NORTH EQUATORIAL 1

You'll be able to view objects on this map on early evenings throughout the autumn in the Northern Hemisphere, or in the spring south of the equator.

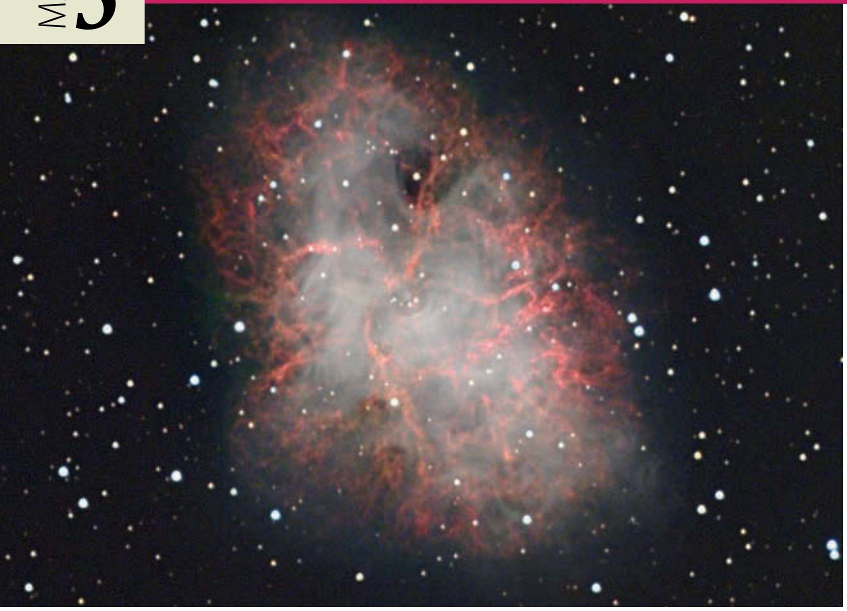

Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


2h
1h
0h
50°
23h
40°
23h
30°
20°
Map 9
2h
1h
0h
CASSIOPEIA
M76
φ
ν
ξ
NGC 147
ο
NGC 185
π
λ
ψ
κ
ι
NGC 7662
ο
NGC 7640
51
φ
ξ
ω
χ
ANDROMEDA
M31
NGC 205
ν
M32
39
υ
τ
θ
ρ
σ
μ
And I
NGC 752
NGC 404
β
π
Jones 1
TRIANGULUM
δ
α
M33
τ
ε
NGC 1
NGC 7741
τ
υ
α
ψ
NGC 7678
NGC 672
υ
φ
ζ
η
χ
φ
β
γ
NGC 772
NGC 7814
γ
PISCES
PEGASUS

◌ Open cluster
⊕ Globular cluster
□ Diffuse nebula
⌖ Planetary nebula
⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega

MAP 5 NORTH EQUATORIAL 2


BRIAN LULA

▲ **THE CRAB NEBULA (M1) is an expanding supernova remnant that appeared as a brilliant new "star" in Taurus in A.D. 1054.**

All around Auriga

Late fall and early winter evenings in the Northern Hemisphere offer three constellations with a wide range of deep-sky objects: Auriga, Taurus, and Gemini. The Milky Way's rich star clouds pass right through Auriga and Gemini and skirt Taurus' eastern edge.

Charles Messier cataloged three objects in Auriga — all open clusters — that fall into a line that runs parallel to the Milky Way. The westernmost is **M38**, which measures 20' across and shines at magnitude 6.4. Through an 8-inch scope, you'll be able to see more than 100 stars. Another open cluster, magnitude 8.2 **NGC 1907**, lies ½° south of M38 and forms a pair with it that's somewhat reminiscent of the Double Cluster in Perseus (see Map 1 or Map 3).

M36, at magnitude 6.0, and **M37**, which shines at magnitude 5.6, complete the triumvirate. You can see all three clusters with your naked eyes from a dark site. Through a telescope, M38 and M36 are excellent targets, but M37 truly is spectacular. A small scope reveals 50 stars in an area 10' across. Through a 12-inch scope, you'll see several hundred stars filling the field of view of a medium-power eyepiece.

Many deep-sky objects in Taurus require at least an 8-inch telescope for you to appreciate them. The exceptions are Taurus' two Messier targets, the **Pleiades** (M45) and the **Crab Nebula** (M1). The Crab Nebula is the best-known supernova remnant in the sky. Find it 1° northwest of 3rd-magnitude Zeta Tauri. Measuring 6' by 4', M1 looks like a notched puff of smoke through small telescopes.

Gemini the Twins contains only one Messier object, magnitude 5.1 **M35**. This open cluster's central 20' contains more than 150 stars, and nearby there's a surprise: a smaller, more condensed star cluster, **NGC 2158**. You'll need to use a high magnification eyepiece in a large scope to break this magnitude 8.6 object into individual stars.

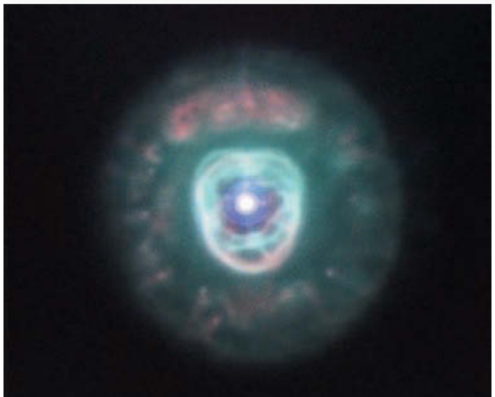
An easy-to-spot planetary nebula in this region is the **Eskimo Nebula** (NGC 2392), also called the Clown-Face Nebula. Shining at magnitude 9.1, this planetary has a double-shell appearance visible through 8-inch and larger telescopes. NGC 2392 measures roughly 1' across.

Continued from page 17

CONSTELLATIONS, PART 2

Constellation	Abbreviation	Pronunciation	Best seen	Map
Lacerta	Lac	lah sir' tah	late Aug.	9
Leo	Leo	lee' owe	early March	12
Leo Minor	LMi	lee' owe my' nor	late Feb.	6
Lepus	Lep	lee' pus	mid-Dec.	17
Libra	Lib	lee' brah	early May	13
Lupus	Lup	loo' pus	early May	19
Lynx	Lyn	links	mid-Jan.	5
Lyra	Lyr	lye' rah	early July	8
Mensa	Men	men' sah	mid-Dec.	22
Microscopium	Mic	my kroh scop' ee um	early Aug.	21
Monoceros	Mon	mon oss' sir us	early Jan.	11
Musca	Mus	mus' kah	late March	23
Norma	Nor	nor' mah	mid-May	23
Octans	Oct	ok' tans	- - - -	24
Ophiuchus	Oph	off ee oo' kus	mid-June	14
Orion	Ori	or eye' on	mid-Dec.	11
Pavo	Pav	pah' voh	mid-July	24
Pegasus	Peg	peg' ah sus	early Sept.	9
Perseus	Per	pur' see us	early Nov.	4
Phoenix	Phe	fee' niks	early Oct.	16
Pictor	Pic	pik' tor	mid-Dec.	22
Pisces	Psc	pye' seez	late Sept.	10
Piscis Austrinus	PsA	pye' sis os try' nus	late Aug.	21
Puppis	Pup	pup' iss	early Jan.	17
Pyxis	Pyx	pik' sis	early Feb.	18
Reticulum	Ret	reh tik' yoo lum	mid-Nov.	22
Sagitta	Sge	sah gee' tah	mid-July	8
Sagittarius	Sgr	sa ji tare' ee us	early July	20
Scorpius	Sco	skor' pee us	early June	20
Sculptor	Scl	skulp' tor	late Sept.	16
Scutum	Sct	skoo' tum	early July	14
Serpens	Ser	sir' pens	early June	14
Sextans	Sex	sex' tans	late Feb.	12
Taurus	Tau	tor' us	late Nov.	5
Telescopium	Tel	tel es koh' pee um	mid-July	20
Triangulum	Tri	try ang' yoo lum	late Oct.	4
Triangulum Australe	TrA	try ang' yoo lum os trail'	late May	23
Tucana	Tuc	too kan' ah	mid-Sept.	24
Ursa Major	UMa	ur' sah may' jor	mid-March	2
Ursa Minor	UMi	ur' sah my' nor	- - - -	2
Vela	Vel	vay' lah	mid-Feb.	18
Virgo	Vir	vir' go	mid-April	13
Volans	Vol	voh' lans	mid-Jan.	22
Vulpecula	Vul	vul pek' yoo lah	late July	9

Note: The "Best seen" column gives the midnight culmination dates for the constellations' central points. These dates indicate when a constellation lies opposite the Sun and is highest at midnight. "Map" indicates where a constellation's central point (in R.A. and Dec.) lies. Parts of Octans and Ursa Minor surround the South and North celestial poles, respectively.



◀ **THE ESKIMO Nebula (NGC 2392) is a planetary nebula in Gemini the Twins. If sky conditions warrant, use magnifications in excess of 200x for the most detailed view.** PETER AND SUZIE ERICKSON/ADAM BLOCK/NOAO/AURA/NSF

THE 30 BRIGHTEST STARS

	Name	Designation	Magnitude	Map
1	Sirius	Alpha Canis Majoris	–1.47	11
2	Canopus	Alpha Carinae	–0.72	17
3	Rigil Kentaurus	Alpha Centauri	–0.29	23
4	Arcturus	Alpha Boötis	–0.04	13
5	Vega	Alpha Lyrae	0.03	8
6	Capella	Alpha Aurigae	0.08	5
7	Rigel	Beta Orionis	0.12	11
8	Procyon	Alpha Canis Minoris	0.34	11
9	Achernar	Alpha Eridani	0.50	22
10	Betelgeuse	Alpha Orionis	0.58	11
11	Hadar	Beta Centauri	0.60	23
12	Altair	Alpha Aquilae	0.77	14
13	Aldebaran	Alpha Tauri	0.85	11
14	Acrux	Alpha Crucis	0.94	23
15	Spica	Alpha Virginis	1.04	13
16	Antares	Alpha Scorpii	1.09	20
17	Pollux	Beta Geminorum	1.15	5
18	Fomalhaut	Alpha Piscis Austrini	1.16	21
19	Deneb	Alpha Cygni	1.25	9
20	Mimosa	Beta Crucis	1.30	23
21	Regulus	Alpha Leonis	1.35	12
22	Adhara	Epsilon Canis Majoris	1.51	17
23	Castor	Alpha Geminorum	1.59	5
24	Shaula	Lambda Scorpii	1.62	20
25	Gacrux	Gamma Crucis	1.63	23
26	Bellatrix	Gamma Orionis	1.64	11
27	Elnath	Beta Tauri	1.65	5
28	Miaplacidus	Beta Carinae	1.68	23
29	Alnilam	Epsilon Orionis	1.70	11
30	Alnair	Alpha Gruis	1.74	21

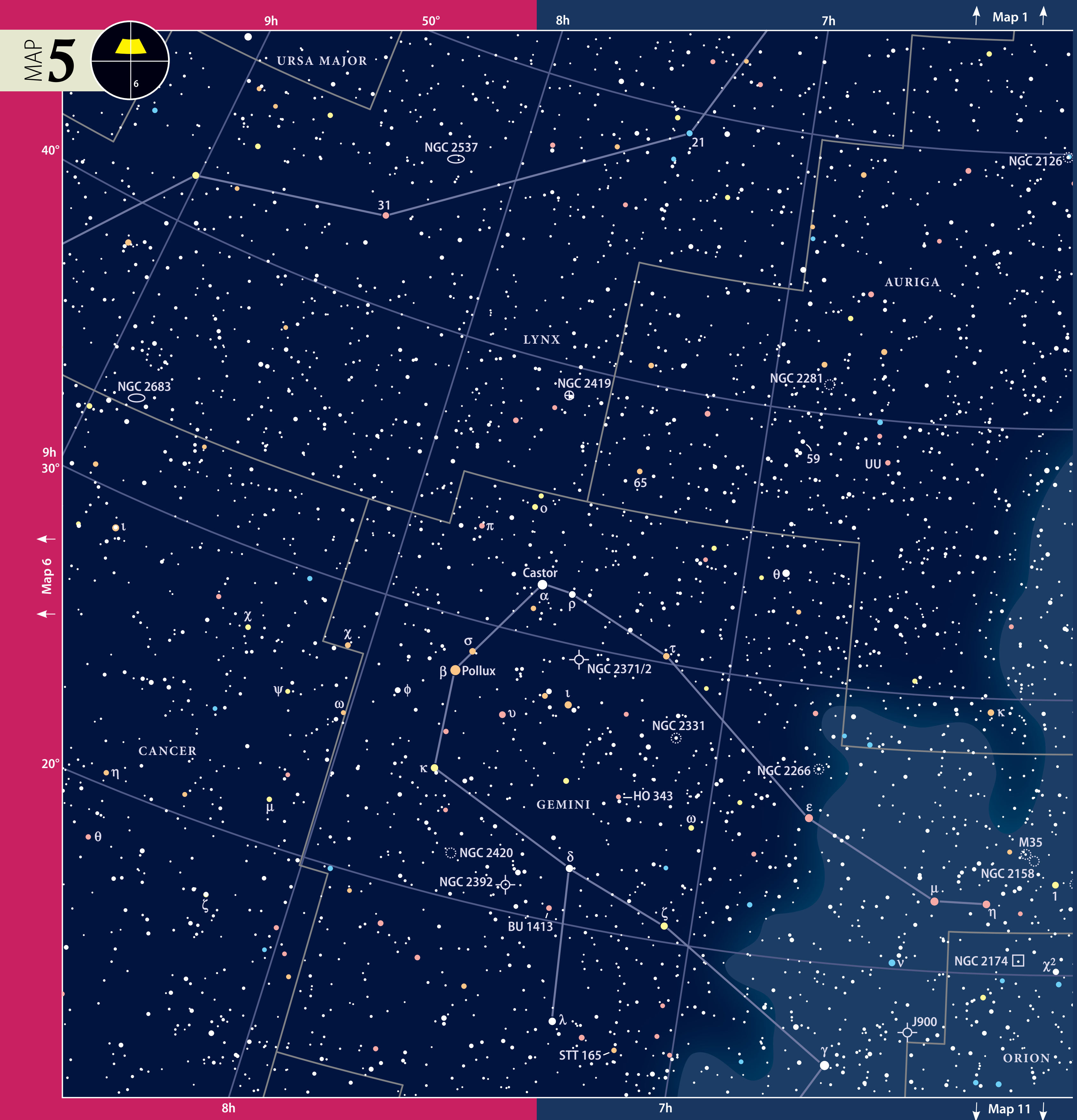
▲ **NGC 1931** in Auriga is a small cluster of stars embedded in nebulosity. It lies in a rich area of sky only 1° west of open cluster M36.

AL AND ANDY FERAVOMI/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE FLAMING STAR NEBULA** (IC 405) in Auriga (left of center) glows because of intense radiation from the star AE Aurigae. ADAM BLOCK/NOAO/AURA/NSF

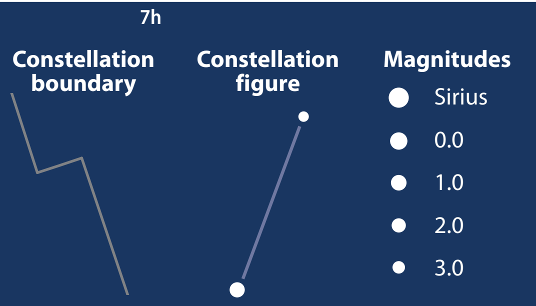
DOUBLE-STAR DELIGHTS — MAP 5

Designation	Right ascension	Declination	Magnitudes	Separation
Struve 479	4h01m	23°11'	6.6, 9.0	8.0"
STT 72	4h08m	17°20'	7.4, 8.0	4.7"
Chi Tauri	4h23m	25°38'	5.5, 7.6	19.5"
Omega Aurigae	4h59m	37°53'	5.1, 8.1	5.3"
5 Aurigae	5h00m	39°24'	6.0, 9.7	3.8"
9 Aurigae	5h07m	51°36'	5.0, 12.2	5.2"
14 Aurigae	5h15m	32°40'	5.2, 7.4	14.6"
16 Aurigae	5h18m	33°22'	4.8, 10.6	4.2"
Struve 680	5h19m	20°07'	6.1, 9.6	9.0"
18 Aurigae	5h19m	33°59'	6.5, 11.8	4.1"
Sigma Aurigae	5h25m	37°23'	5.2, 11.2	8.7"
26 Aurigae	5h39m	30°30'	5.5, 8.0	12.4"
Theta Aurigae	5h59m	37°12'	2.7, 7.2	3.5"
41 Aurigae	6h12m	48°42'	6.1, 6.8	7.7"
59 Aurigae	6h53m	38°51'	6.2, 9.5	22.3"
STT 165	7h08m	15°56'	5.6, 11.3	10.4"
HO 343	7h14m	24°53'	6.0, 12.7	23.9"
Lambda Geminorum	7h18m	16°32'	3.6, 10.7	9.6"
Delta Geminorum	7h20m	21°59'	3.5, 8.5	6.2"
BU 1413	7h22m	20°26'	5.2, 12.2	16.5"
65 Aurigae	7h22m	36°45'	5.2, 11.7	11.4"
Rho Geminorum	7h29m	31°46'	4.2, 12.5	3.4"
Kappa Geminorum	7h44m	24°23'	3.7, 8.2	7.1"
Pi Geminorum	7h48m	33°25'	5.3, 11.4	21.0"


MAP 5
6
9h
50°
8h
7h
Map 1
URSA MAJOR
40°
NGC 2537
21
NGC 2126
31
AURIGA
LYNX
NGC 2683
NGC 2419
NGC 2281
9h
30°
59
UU
65
ο
ι
π
Map 6
Castor
α
ρ
θ
χ
χ
σ
τ
β Pollux
NGC 2371/2
ψ
φ
ω
ι
υ
NGC 2331
κ
CANCER
20°
η
κ
NGC 2266
GEMINI
HO 343
ε
μ
ω
θ
M35
NGC 2420
δ
NGC 2158
NGC 2392
ζ
μ
1
η
BU 1413
ζ
ν
NGC 2174
χ²
λ
J900
STT 165
γ
ORION
8h
7h
Map 11

NORTH EQUATORIAL 2

This map shows objects on early evenings in autumn and early winter north of the equator, and in spring and summer south of that line.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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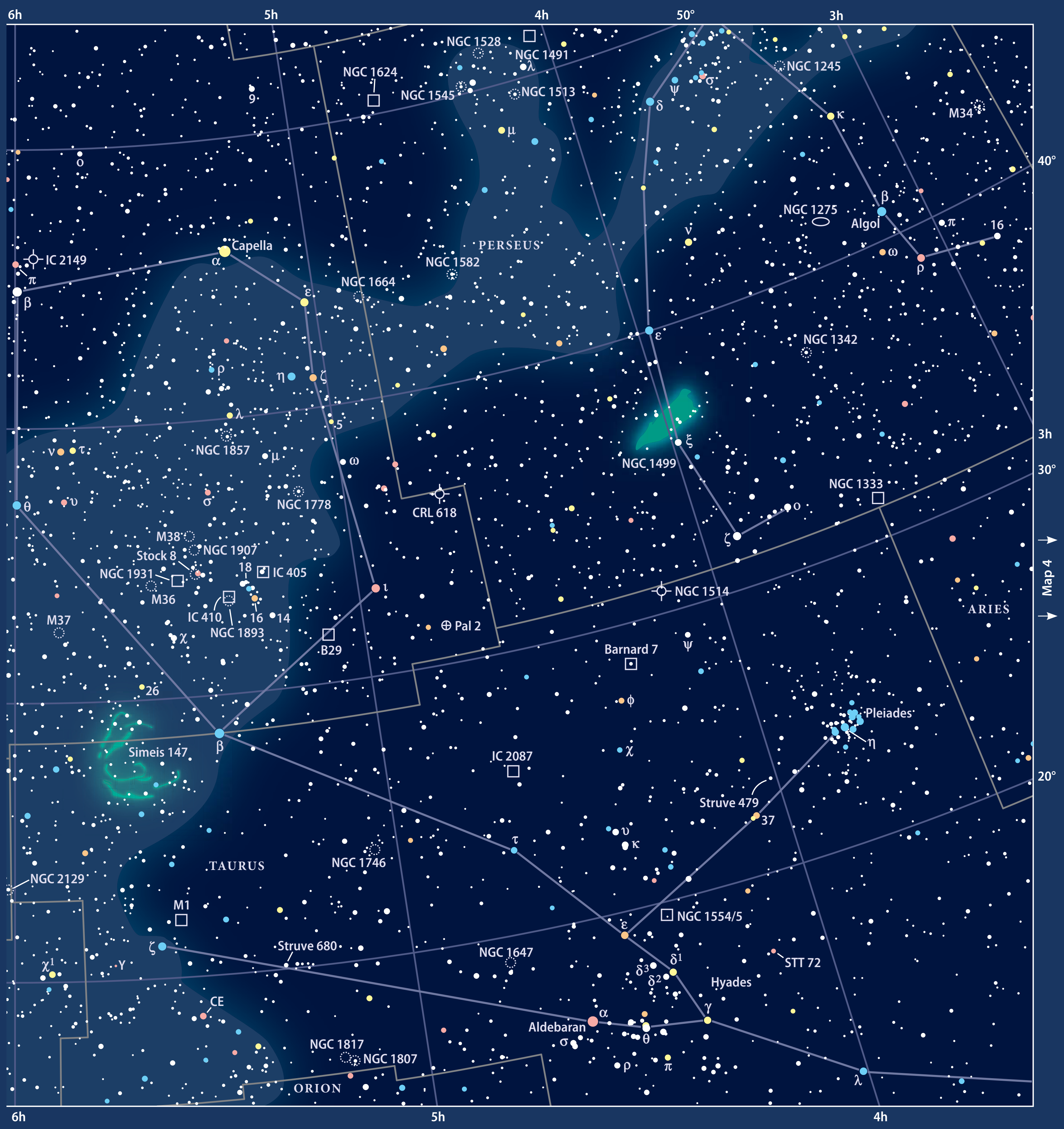
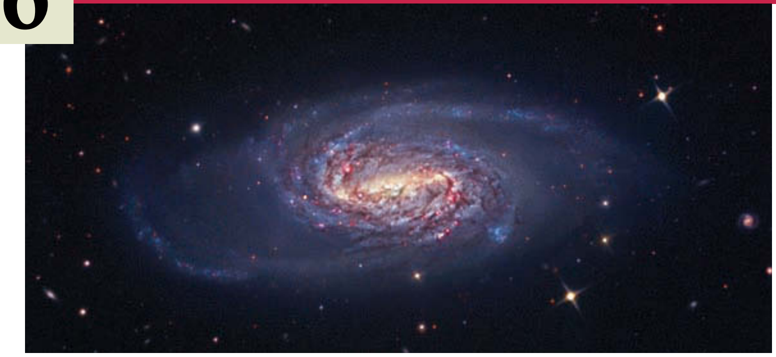
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


6h
5h
4h
50°
3h
40°
30°
20°
3h
Map 4
NGC 1528
NGC 1491
λ
NGC 1624
NGC 1545
NGC 1513
NGC 1245
9
δ
ψ
σ
κ
M34
μ
o
PERSEUS
NGC 1275
β
Algol
π
16
ω
ρ
IC 2149
π
Capella
α
β
ν
NGC 1582
ε
NGC 1664
ε
NGC 1342
ρ
η
ζ
λ
5
ξ
NGC 1499
ν
τ
NGC 1857
μ
ω
θ
υ
σ
NGC 1778
CRL 618
o
NGC 1333
ζ
M38
NGC 1907
Stock 8
18
IC 405
NGC 1931
M36
ι
NGC 1514
IC 410
16
14
NGC 1893
M37
χ
B29
Pal 2
Barnard 7
ψ
ARIES
26
ϕ
Pleiades
η
Simeis 147
β
IC 2087
χ
Struve 479
37
υ
κ
NGC 1746
TAURUS
τ
NGC 2129
M1
ε
NGC 1554/5
Struve 680
ζ
NGC 1647
δ1
δ3
δ2
STT 72
Hyades
χ1
Y
CE
α
Aldebaran
γ
σ
θ
NGC 1817
NGC 1807
ρ
π
λ
ORION
6h
5h
4h

◌	Open cluster
⊕	Globular cluster
□	Diffuse nebula
⌖	Planetary nebula
⬭	Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	ϕ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

MAP 6 NORTH EQUATORIAL 3



TONY AND DAPHNE HALLAS

▲ **THE SPECTACULAR magnitude 8.9 spiral galaxy NGC 2903 in Leo is not in Messier's catalog or the Caldwell catalog.**

Winter galaxies

The star map on the following pages covers a region visible in the eastern sky on late February evenings north of the equator. It features Cancer the Crab, the northern part of Leo the Lion, Leo Minor the Lion Cub, and the southern portion of Ursa Major the Great Bear. Apart from Cancer's two open star clusters cataloged by Charles Messier, this deep-sky region features galaxies — including some great ones.

Unfortunately, Cancer is a faint constellation. If your sky is even moderately light-polluted, finding it may be a chore. The easiest way is to draw a line from Castor and Pollux, the brightest stars of Gemini, to Regulus, the brightest star of Leo. Cancer lies at the mid-point of this line.

At Cancer's center lies the **Beehive Cluster** (M44). You also may hear this object referred to as the Praesepe. To the naked eye from a dark site, M44 looks like a uniform haze against a starless background. This is not an object for large telescopes. Use 7x50 or 10x50 binoculars or a telescope/eyepiece combination that gives at least a 2° field of view.

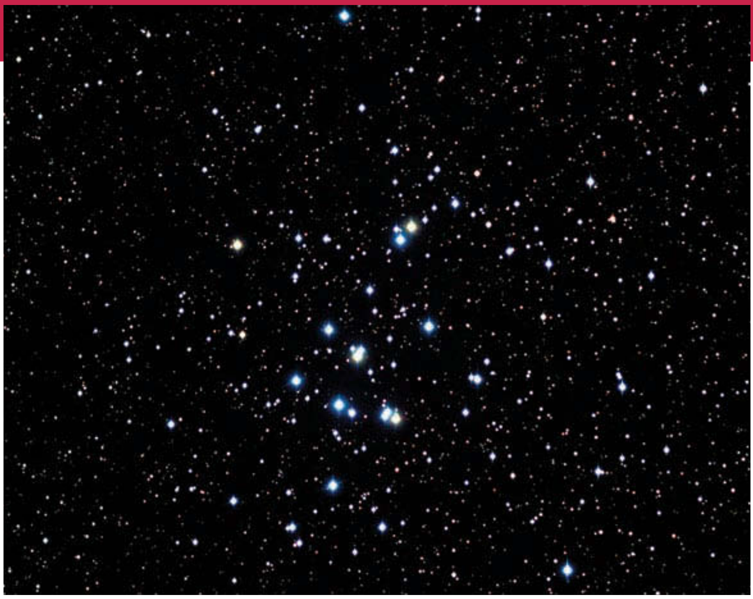
Now it's time to observe some galaxies. One thing longtime observers have learned is that, no matter how big your scope is, you'll want a bigger one when you're looking at galaxies. Galaxies aren't that bright, and their light spreads out over a much larger area than, say, a planet. This doesn't mean a small scope won't show anything, just that more details emerge as you increase aperture. Also, do your best to get away from any light pollution when you observe galaxies. The cores of the brightest galaxies may still show through, but you'll lose any detail in spiral arms or other outer regions. Finally, filters — which allow only a selected portion of light through — don't help. Galaxies contain all types of objects, so the light they emit contains a broad swath of the spectrum. Using a filter to view a galaxy simply will make it appear fainter.

Find Lambda Leonis just west of the Sickle of Leo and move 1½° south to the magnitude 9.0 spiral galaxy **NGC 2903**. A 10-inch telescope shows a halo measuring 4' by 2' surrounding the galaxy's bright nucleus.

At the southern tip of Leo Minor, find **NGC 3344**, a magnitude 9.9 face-on spiral galaxy. A big scope shows the spiral arms well. Through small scopes, you'll see the nucleus surrounded by a faint, mottled area.

Find Mu Ursae Majoris near the border with Leo Minor and move ¾° west to **NGC 3184**. This magnitude 9.8 galaxy is a spiral, but you'll need at least an 8-inch scope to prove that to yourself. In a smaller scope, you'll see a uniform 4'-wide spot, with only a slight brightening in the center.

For a real galactic treat, look 5½° east of Chi Ursae Majoris for spiral galaxy **M106**. This magnitude 8.3 wonder displays spiral arms with bright blue areas, which are star-forming regions, and vast dust lanes.



TOM BASH AND JOHN FOX/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE BEEHIVE Cluster (M44) is an easy naked-eye object from a dark site. Because it's big, use binoculars or a low-power telescope/eyepiece combination to view it.**

◀ **SPIRAL GALAXY NGC 3486 is a compact object that glows at magnitude 10.3. You'll need a big scope to see detail in its spiral arms.** ADAM BLOCK/JEFF HAPEMAN/NOAO/AURA/NSF

/// DOUBLE-STAR DELIGHTS — MAP 6

Designation	Right ascension	Declination	Magnitudes	Separation
Zeta Cancri	8h12m	17°39'	5.6, 6.3	5.3"
STF 1224	8h27m	24°32'	7.1, 7.6	5.7"
Phi^2 Cancri	8h27m	26°56'	6.3, 6.3	5.1"
Iota Ursae Majoris	8h59m	48°02'	3.9, 9.5	4.5"
66 Cancri	9h01m	32°15'	5.9, 8.0	4.5"
75 Cancri	9h09m	26°37'	6.0, 9.1	12.0"
KUI 42	9h42m	31°17'	5.9, 13.6	28.4"
HJ 469	9h45m	18°52'	6.5, 12.6	31.2"
KUI 49	10h19m	46°46'	6.5, 12.2	27.8"
Gamma Leonis	10h20m	19°50'	2.6, 3.8	4.5"
40 Leo Minoris	10h43m	26°19'	5.6, 12.6	18.4"
54 Leonis	10h56m	24°45'	4.5, 6.3	6.5"
51 Ursae Majoris	11h05m	38°14'	6.1, 12.6	8.2"
Nu Ursae Majoris	11h19m	33°05'	3.7, 10.1	7.3"
57 Ursae Majoris	11h29m	39°20'	5.4, 8.4	5.5"
HJ 503	11h36m	27°46'	5.8, 10.2	21.6"
65 Ursae Majoris	11h55m	46°29'	6.7, 8.3	3.7"

/// MESSIER MARATHON SEARCH ORDER — 1

Messier no.	NGC no.	Constellation	Type	Magnitude	Map
M77	1068	Cetus	Gal	8.9	10
M74	628	Pisces	Gal	8.5	10
M33	598	Triangulum	Gal	5.7	4
M31	224	Andromeda	Gal	3.4	4
M32	221	Andromeda	Gal	8.2	4
M52	7654	Cassiopeia	OC	6.9	3
M103	581	Cassiopeia	OC	7.4	1
M76	650	Perseus	PN	10.1	4
M34	1039	Perseus	OC	5.2	4
M45	- - - -	Taurus	OC	1.5	4
M79	1904	Lepus	GC	7.7	17
M42	1976	Orion	N	3.7	11
M43	1982	Orion	N	6.8	11
M78	2068	Orion	N	8.0	11
M1	1952	Taurus	SNR	8.0	5
M35	2168	Gemini	OC	5.1	5
M37	2099	Auriga	OC	5.6	5
M36	1960	Auriga	OC	6.0	5
M38	1912	Auriga	OC	6.4	5
M41	2287	Canis Major	OC	4.5	17
M93	2447	Puppis	OC	6.2	17
M47	2422	Puppis	OC	4.4	11
M46	2437	Puppis	OC	6.1	11
M50	2323	Monoceros	OC	5.9	11
M48	2548	Hydra	OC	5.8	12
M44	2632	Cancer	OC	3.1	6
M67	2682	Cancer	OC	6.9	12
M95	3351	Leo	Gal	9.7	12
M96	3368	Leo	Gal	9.2	12
M105	3379	Leo	Gal	9.3	12
M65	3623	Leo	Gal	8.8	12
M66	3627	Leo	Gal	9.0	12
M81	3031	Ursa Major	Gal	6.9	2
M82	3034	Ursa Major	Gal	8.4	2
M97	3587	Ursa Major	PN	9.9	2
M108	3556	Ursa Major	Gal	10.0	2
M109	3992	Ursa Major	Gal	9.8	2
M40	Win4	Ursa Major	Dbl	9.0/9.6	2
M106	4258	Canes Venatici	Gal	8.3	7
M94	4736	Canes Venatici	Gal	8.2	7
M63	5055	Canes Venatici	Gal	8.6	7
M51	5194	Canes Venatici	Gal	8.4	7
M101	5457	Ursa Major	Gal	7.9	2
M102	5866	Draco	Gal	10.0	2
M53	5024	Coma Berenices	GC	7.7	7
M64	4826	Coma Berenices	Gal	8.5	7
M3	5272	Canes Venatici	GC	6.3	7
M98	4192	Coma Berenices	Gal	10.1	13
M99	4254	Coma Berenices	Gal	9.9	13
M100	4321	Coma Berenices	Gal	9.3	13
M85	4382	Coma Berenices	Gal	9.1	13
M84	4374	Virgo	Gal	9.1	13
M86	4406	Virgo	Gal	8.9	13
M87	4486	Virgo	Gal	8.6	13

KEY:
Dbl = Double star
Gal = Galaxy
GC = Globular cluster
N = Nebula
OC = Open cluster
PN = Planetary nebula
SC = Star cloud
SNR = Supernova remnant

Continued on page 29

ADAM BLOCK/NOAO/AURA/NSF

▲ **HICKSON 44 is a compact galaxy group in Leo comprising elliptical galaxy NGC 3193 (left), tightly wound spiral galaxy NGC 3190 (center), and S-shaped spiral NGC 3187.**

THE MESSIER OBJECTS — 109 DEEP-SKY TREATS

Charles Messier (1730–1817) was a French comet-hunter. He occasionally encountered celestial objects that looked like comets because they appeared fuzzy in his small telescope. These objects didn't move against the starry background, however. Astronomers of the day called these objects nebulae, after the Latin word for "cloud," but the word has a more specific meaning today. The catalog Messier eventually compiled contains open and globular star clusters, galaxies, and both bright and planetary nebulae.

Messier discovered the first of his non-moving objects in Taurus on August 28, 1758. This object became his first catalog entry — M1. Messier published three versions of his catalog. The first, in 1769, contained 45 objects. The second, with 68 objects, appeared in 1780. The third, containing 103 objects, appeared the next year. Later discoveries by Messier and others brought the final tally of objects to 109.

Messier marathons

Because the distribution of Messier's objects is uneven across the sky, a window exists when observers can see all 109 in a single night. Messier marathons have been popular with astronomy clubs since the early 1970s. One of the first extended mentions of the Messier marathon as an event appeared in the Forum section of the March 1980 issue of *Astronomy*, authored by California comet-hunter Don Machholz.

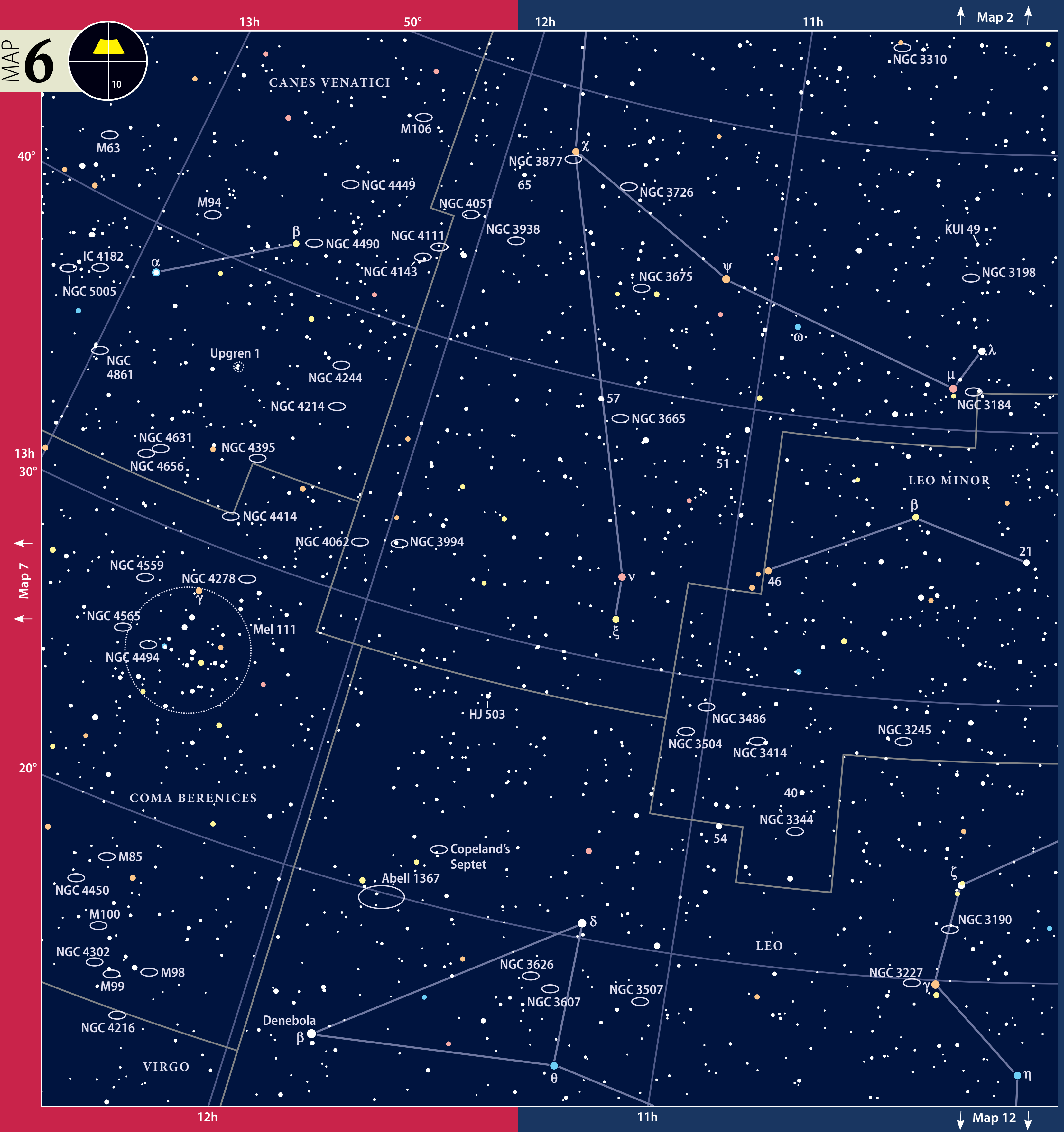
Tom Polakis, of Arizona City, Arizona, calculated the window of opportunity for a complete Messier marathon. The observing window begins on the date when globular cluster M30 is high enough to see in a dark morning sky. Working with the premise that the object has to be at an altitude of 2° for an observer to see it, Polakis calculated the Sun's altitude at that time and its distance from M30. On the evening end, the limiting object is spiral galaxy M74. Seeing it defines the end of the window of observing dates.

His numbers are for 33° north latitude, and Polakis adds they get more favorable as you observe farther south, particularly for M30. The beginning of the season is March 17. Using the same criterion for the evening view of M74, the marathon season ends April 3.

Can you see them all?

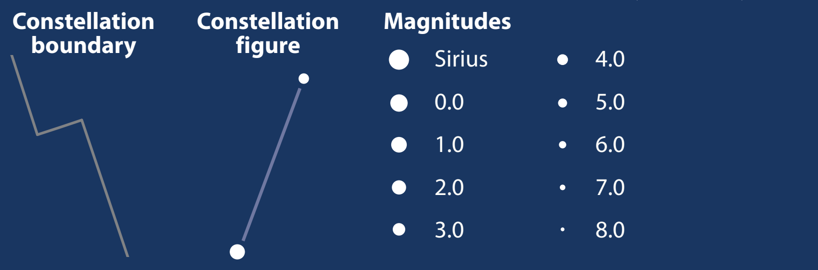
Many observers have viewed all the Messier objects during a single night. You need a high-quality 3-inch or larger scope and a clear, dark, mid-northern-latitude site. Observe around New Moon. Some observers challenge themselves by trying to see as many M-objects as possible through small telescopes or binoculars. Whichever approach you take, the list on this page and page 29 will help you order your search. Don't rush, even through the close-knit Virgo galaxies. You'll have plenty of time to observe these objects. In fact, there's even a period — from about midnight to 3 A.M. local time — when you can get some sleep. Whether you take advantage of this or not depends on how much fun you're having with your fellow observers.

MAP 6


10
13h
50°
12h
11h
Map 2
40°
13h
30°
20°
Map 7
12h
11h
Map 12
CANES VENATICI
COMA BERENICES
LEO MINOR
LEO
VIRGO
M63
M106
NGC 3310
NGC 3877
χ
65
NGC 4449
NGC 3726
M94
NGC 4051
NGC 3938
β
NGC 4490
NGC 4111
KUI 49
IC 4182
α
NGC 4143
ψ
NGC 3675
NGC 3198
NGC 5005
ω
λ
μ
NGC 4861
Upgren 1
NGC 4244
NGC 3184
57
NGC 4214
NGC 3665
NGC 4631
NGC 4395
51
NGC 4656
β
NGC 4414
NGC 4062
NGC 3994
21
ν
46
NGC 4559
NGC 4278
γ
NGC 4565
Mel 111
ξ
NGC 4494
HJ 503
NGC 3486
NGC 3245
NGC 3504
NGC 3414
40
NGC 3344
54
M85
Copeland's Septet
NGC 4450
Abell 1367
ζ
M100
δ
NGC 3190
NGC 4302
NGC 3626
NGC 3227
M98
γ
M99
NGC 3507
NGC 3607
NGC 4216
Denebola
β
θ
η

NORTH EQUATORIAL 3

This map shows constellations and deep-sky objects that rise after sunset in late winter and early spring in the Northern Hemisphere.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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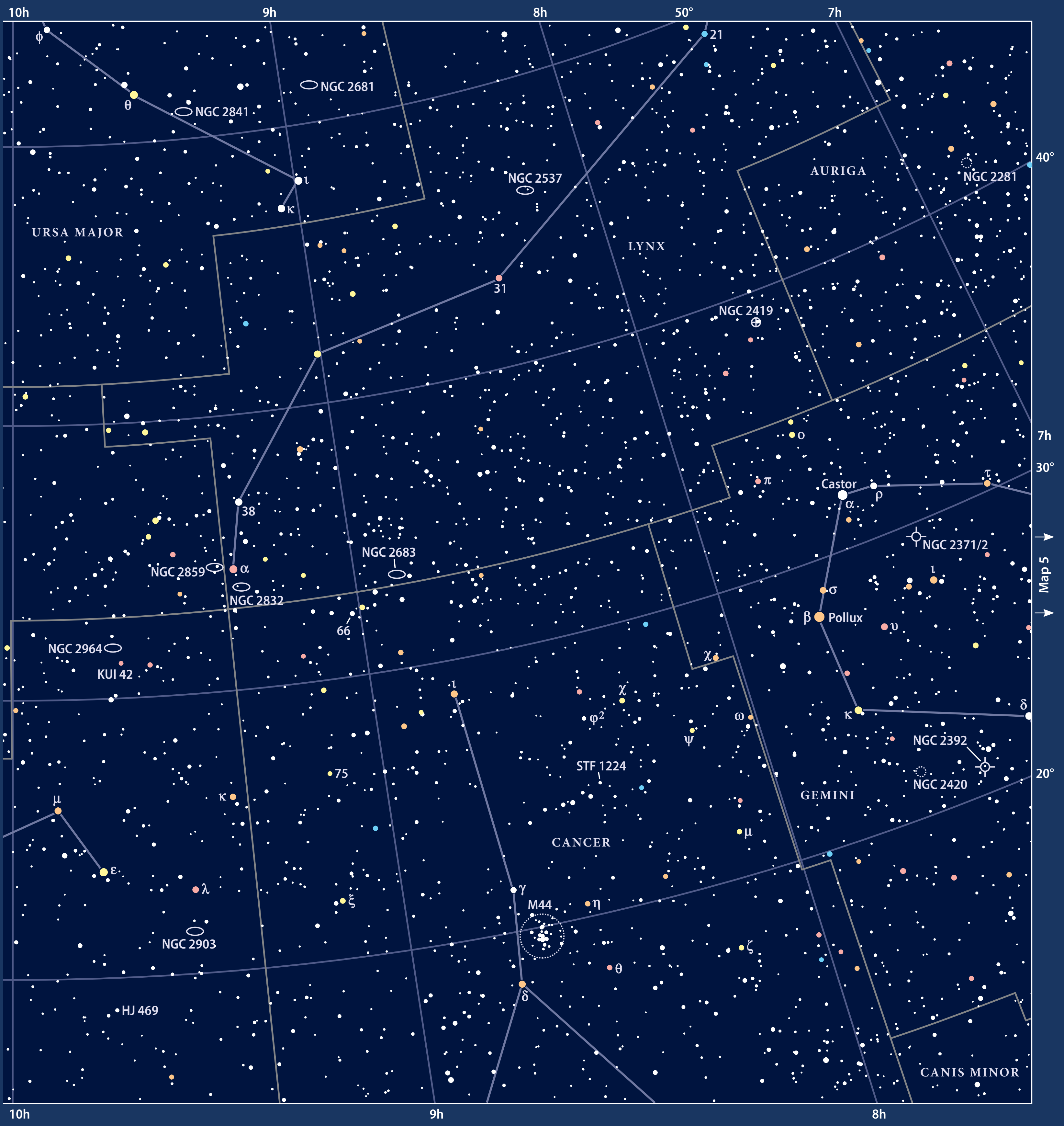
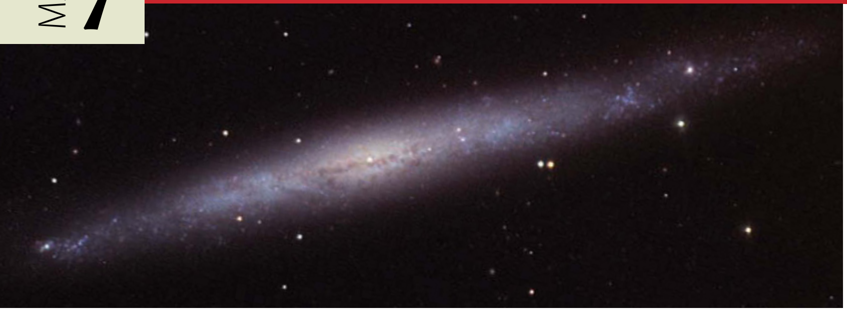
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


10h
9h
8h
50°
7h
40°
7h
30°
20°
10h
9h
8h
Map 5
URSA MAJOR
LYNX
AURIGA
GEMINI
CANCER
CANIS MINOR
NGC 2681
NGC 2841
NGC 2537
NGC 2281
NGC 2419
NGC 2683
NGC 2859
NGC 2832
NGC 2964
KUI 42
NGC 2371/2
NGC 2392
NGC 2420
STF 1224
M44
NGC 2903
HJ 469
Castor
Pollux
φ
θ
ι
κ
21
31
38
α
66
75
ο
π
ρ
τ
α
σ
β
υ
ι
χ
χ
φ²
ψ
ω
ι
κ
δ
μ
ε
λ
κ
ξ
γ
η
μ
ζ
θ
δ

- ◌ Open cluster
- ⊕ Globular cluster
- ☐ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	ϕ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		



▲ **NGC 4244** in Canes Venatici is 7 times longer than it is wide. As you look toward the nucleus, you won't see much detail beyond a gradual brightening. JOE NAUGHTON AND STEVE STAFFORD/ADAM BLOCK/NOAO/AURA/NSF

Bright galaxies

The next map, like the last, is chock-full of bright galaxies. They mainly reside in the 38th-largest constellation, Canes Venatici, and in Coma Berenices, number 42 on the constellation-size list. In contrast, the 13th-largest constellation, Boötes, has far fewer deep-sky objects.

Start by observing two globular clusters. Magnitude 9.2 **NGC 5466** in Boötes appears uniform in brightness. A 12-inch scope reveals two dozen bright stars set against a background glow of unresolvable faint stars.

The other globular is **M3** in Canes Venatici's southern reaches. It lies midway between Cor Caroli (Alpha Canum Venaticorum) and Arcturus (Alpha Boötis). Even small telescopes reveal a lot of detail in this magnitude 6.3 cluster, but point a 12-inch its way, and you'll find a grainy sphere with a bright center and more than 100 stars near its edge.

Also in Canes Venatici, you'll find such standout galaxies as the **Sunflower Galaxy** (M63) and the fabulous **Whirlpool Galaxy** (M51). Point any scope at these objects under a dark sky, and you won't be disappointed. But lesser-known star cities also inhabit this constellation.

Almost 3° north of Beta Canum Venaticorum lies the irregular galaxy **NGC 4449**. This galaxy has quite a different appearance: rectangular. It measures 4' by 2' and shines at magnitude 9.6.

Look 2° southwest of 5th-magnitude 6 Canum Venaticorum for **NGC 4244**. This magnitude 10.4 edge-on spiral galaxy shows disparity between its length and width — it measures 15' by 2'.

Find **NGC 5005** 3° southeast of Alpha Canum Venaticorum. This magnitude 9.8 spiral is an oval twice as long as wide. Most telescopes allow you to pick out an extended central region with a bright nucleus. A nice foreground star shines at 9th magnitude 12' west of NGC 5005.

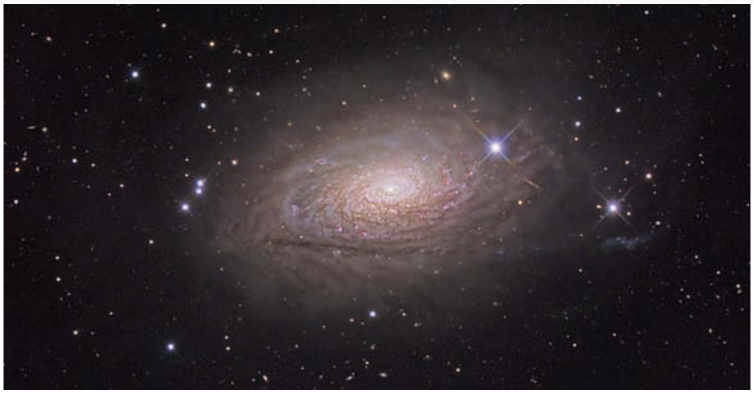
Coma Berenices contains eight Messier objects, seven of which are galaxies. The exception is globular cluster **M53**, which lies 1° northeast of Alpha Comae Berenices. You can resolve the outer stars of this magnitude 7.7 object, but its central region, although broad, is too concentrated.

The galaxies Messier cataloged (**M64**, **M85**, **M88**, **M91**, **M98**, **M99**, and **M100**) are all spirals and worth detailed observing sessions. A fun way to compare these objects is to make small sketches of them on the same sheet of paper. An example of an elliptical galaxy is **NGC 4494**, which lies 3° south-southeast of Gamma Comae Berenices. This magnitude 9.8 galaxy measures 2' across and is ever-so-slightly oval.

Cap off your night viewing objects in Coma with **NGC 4565**, a spectacular magnitude 9.6 edge-on spiral with a small central bulge. Large scopes will reveal a dust lane; it runs the whole length of the galaxy but is easiest to see silhouetted against the core.

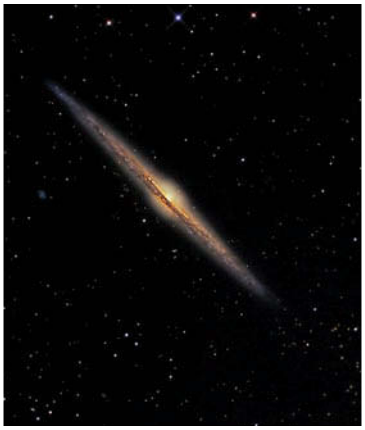
DOUBLE-STAR DELIGHTS — MAP 7

Designation	Right ascension	Declination	Magnitudes	Separation
2 Canum Venaticorum	12h16m	40°39'	5.9, 8.2	11.5"
11 Comae Berenices	12h21m	17°47'	4.9, 12.9	9.1"
24 Comae Berenices	12h35m	18°22'	5.2, 6.7	20.3"
35 Comae Berenices	12h53m	21°14'	5.1, 9.1	28.7"
Alpha Canum Venaticorum	12h56m	38°18'	2.9, 5.4	19.4"
BU 925	12h57m	43°33'	7.0, 12.5	6.9"
1 Boötis	13h41m	19°57'	5.7, 8.6	4.7"
Tau Boötis	13h47m	17°27'	4.5, 11.1	4.8"
HJ 1244	13h53m	42°11'	7.0, 11.5	6.9"
Kappa Boötis	14h14m	51°47'	4.6, 6.6	13.4"
Pi^1 Boötis	14h41m	16°25'	4.9, 5.8	5.6"
Struve 1884	14h48m	24°22'	6.4, 7.8	2.3"
STT 289	14h56m	32°17'	6.1, 9.6	4.7"
Zeta^2 Coronae Borealis	15h39m	36°38'	5.1, 6.0	6.3"



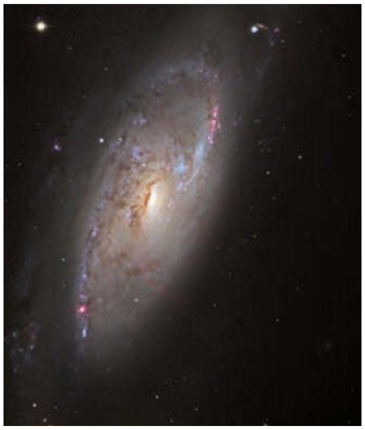
R. JAY GABANY

▲ **THE SUNFLOWER GALAXY** (M63) looks like a disk with a bright center when seen through a small telescope. Larger instruments bring out the arms' spiral structure. M63 shines at magnitude 8.6.



R. JAY GABANY

▲ **EDGE-ON SPIRAL GALAXY** NGC 4565 in Coma Berenices shows a small central bulge. Large telescopes will show the dust lane running lengthwise along the galaxy.



ADRIAN ZSILAVEC AND MICHELLE QUALLS/ADAM BLOCK/NOAO/AURA/NSF

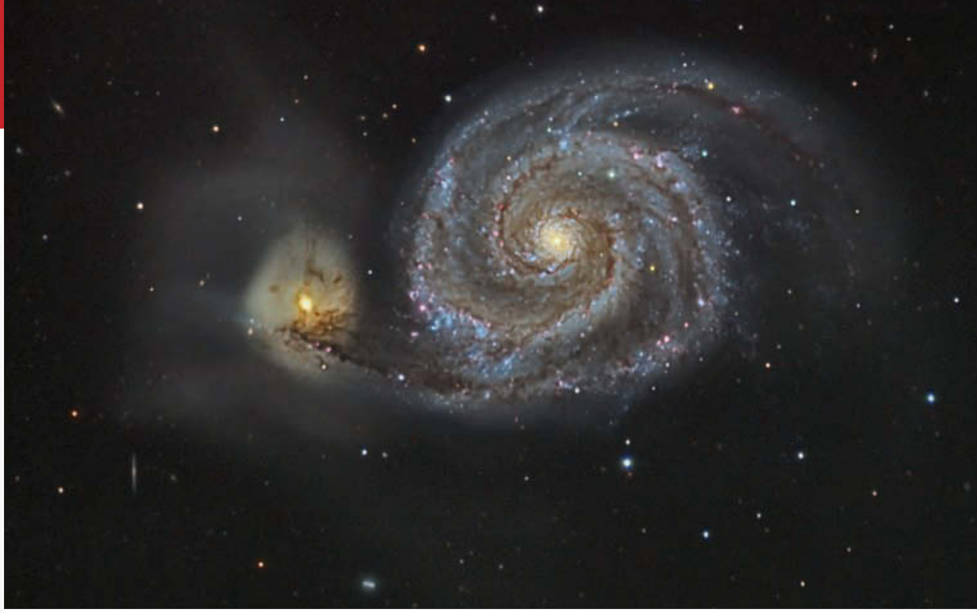
▲ **SPIRAL GALAXY** M106 in Canes Venatici offers lots of detail for observers with 8-inch and larger telescopes: a bright, elongated nucleus; dust lanes; and two large spiral arms.

/// MESSIER MARATHON SEARCH ORDER — 2

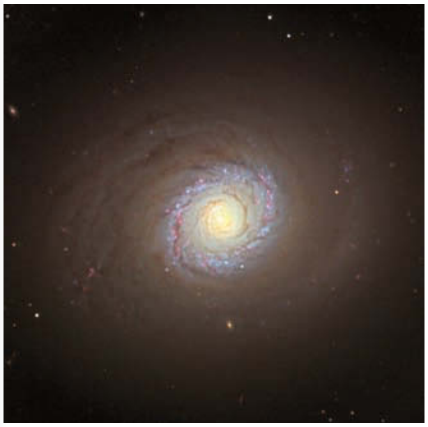
Continued from page 25

Messier no.	NGC no.	Constellation	Type	Magnitude	Map
M89	4552	Virgo	Gal	9.7	13
M90	4569	Virgo	Gal	9.5	13
M88	4501	Coma Berenices	Gal	9.6	13
M91	4548	Coma Berenices	Gal	10.1	13
M58	4579	Virgo	Gal	9.6	13
M59	4621	Virgo	Gal	9.6	13
M60	4649	Virgo	Gal	8.8	13
M49	4472	Virgo	Gal	8.4	13
M61	4303	Virgo	Gal	9.6	13
M104	4594	Virgo	Gal	8.0	13
M68	4590	Hydra	GC	7.6	19
M83	5236	Hydra	Gal	7.5	19
M5	5904	Serpens	GC	5.7	13
M13	6205	Hercules	GC	5.8	8
M92	6341	Hercules	GC	6.5	8
M57	6720	Lyra	PN	8.8	8
M56	6779	Lyra	GC	8.4	8
M29	6913	Cygnus	OC	6.6	9
M39	7092	Cygnus	OC	4.6	9
M27	6853	Vulpecula	PN	7.3	8
M71	6838	Sagitta	GC	8.0	8
M107	6171	Ophiuchus	GC	7.8	14
M12	6218	Ophiuchus	GC	6.1	14
M10	6254	Ophiuchus	GC	6.6	14
M14	6402	Ophiuchus	GC	7.6	14
M9	6333	Ophiuchus	GC	7.8	20
M4	6121	Scorpius	GC	5.4	20
M80	6093	Scorpius	GC	7.3	20
M19	6273	Ophiuchus	GC	6.8	20
M62	6266	Ophiuchus	GC	6.4	20
M6	6405	Scorpius	OC	4.2	20
M7	6475	Scorpius	OC	3.3	20
M11	6705	Scutum	OC	5.8	14
M26	6694	Scutum	OC	8.0	14
M16	6611	Serpens	N	6.0	14
M17	6618	Sagittarius	N	7.0	14
M18	6613	Sagittarius	OC	6.9	14
M24	6603	Sagittarius	SC	2.5	20
M25	IC 4725	Sagittarius	OC	4.6	20
M23	6494	Sagittarius	OC	5.5	20
M21	6531	Sagittarius	OC	5.9	20
M20	6514	Sagittarius	N	9.0	20
M8	6523	Sagittarius	N	6.0	20
M28	6626	Sagittarius	GC	6.9	20
M22	6656	Sagittarius	GC	5.2	20
M69	6637	Sagittarius	GC	7.4	20
M70	6681	Sagittarius	GC	7.8	20
M54	6715	Sagittarius	GC	7.2	20
M55	6809	Sagittarius	GC	6.3	20
M75	6864	Sagittarius	GC	8.6	21
M15	7078	Pegasus	GC	6.3	15
M2	7089	Aquarius	GC	6.6	15
M72	6981	Aquarius	GC	9.2	15
M73	6994	Aquarius	OC	8.9	15
M30	7099	Capricornus	GC	6.9	21

KEY:
Gal = Galaxy
GC = Globular cluster
N = Nebula
OC = Open cluster
PN = Planetary nebula
SC = Star cloud

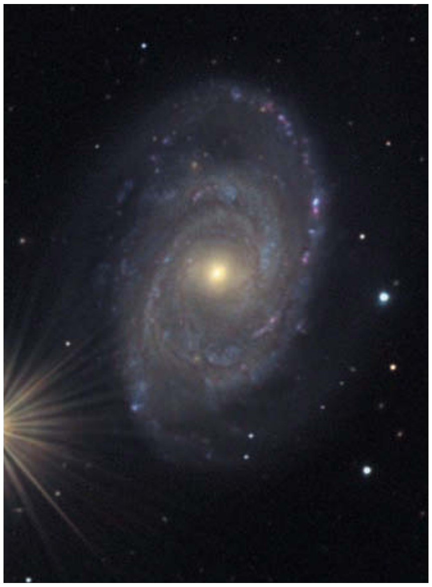


▲ **THE WHIRLPOOL GALAXY** (M51) in Canes Venatici is easy to find because it sits 3½° from Alkaid (Eta Ursae Majoris), which is the end star in the Big Dipper's handle. R. JAY GABANY



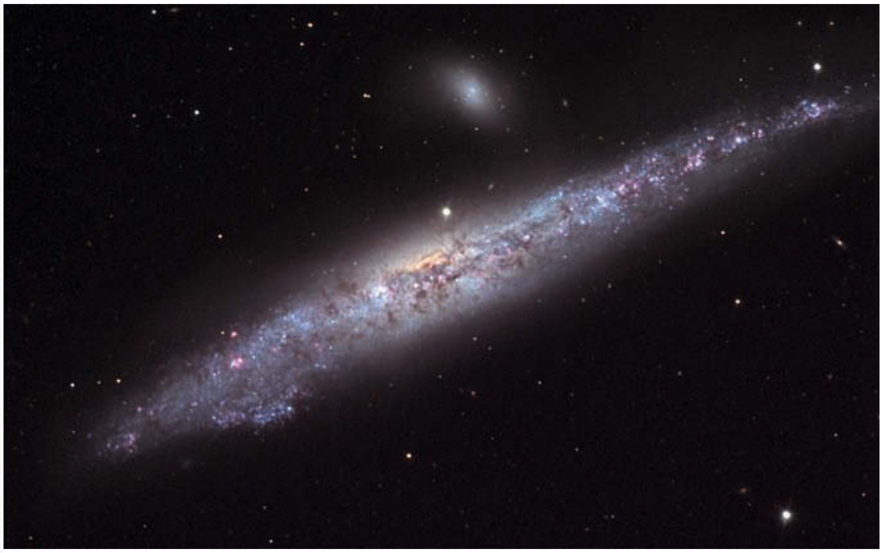
ADAM BLOCK/NOAO/AURA/NSF

▲ **THROUGH A SMALL TELESCOPE,** M94 in Canes Venatici looks like an elliptical galaxy. Actually, it's a bright (magnitude 8.2) spiral galaxy with tightly wound arms.



JOE JORDAN/ADAM BLOCK/NOAO/AURA/NSF

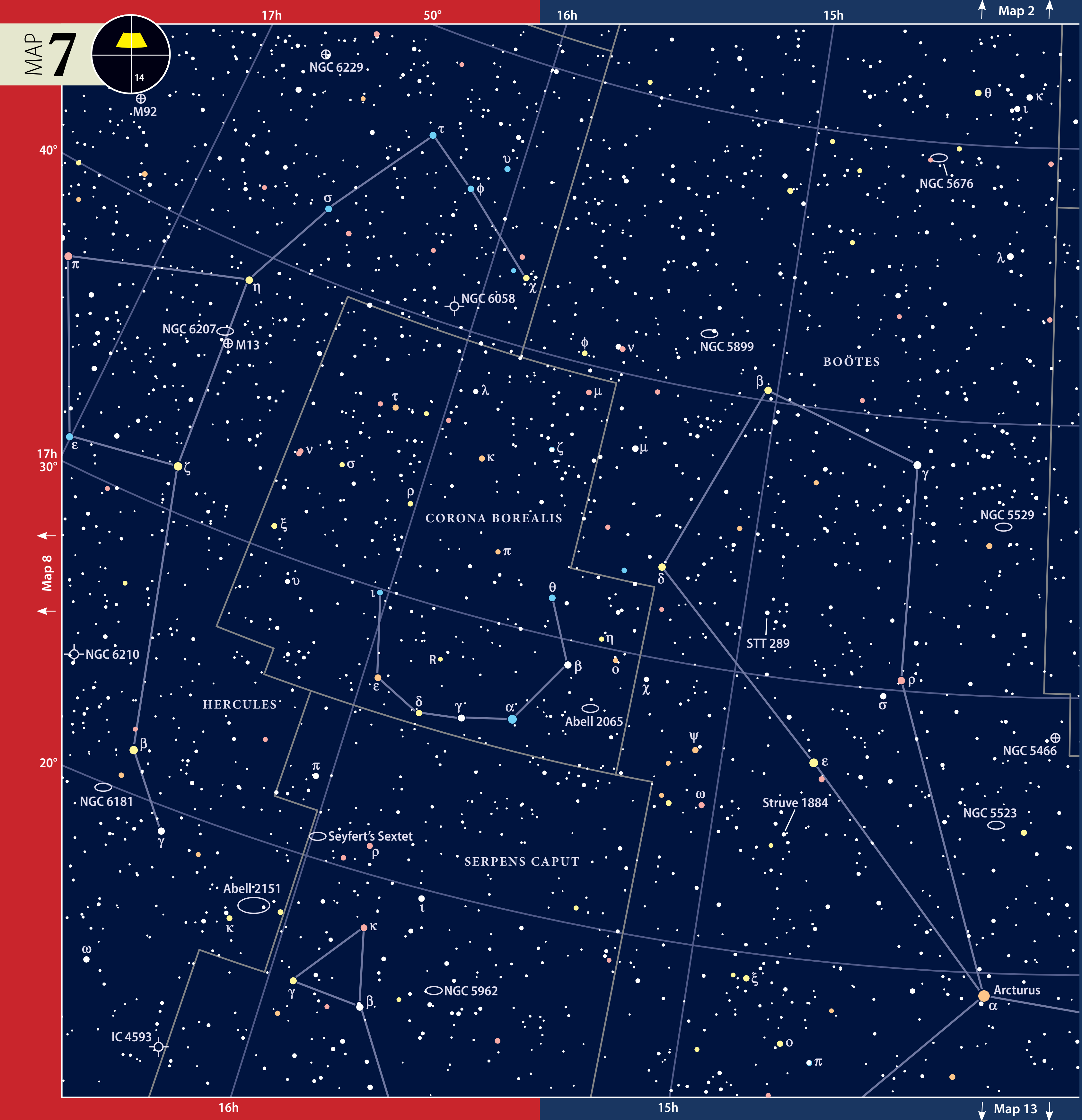
▲ **SPIRAL GALAXY** NGC 5371 in Canes Venatici has a bright core and faint arms. The nearby bright star is magnitude 8.7 SAO 44805. It lies 2' from NGC 5371's center.



JOHN VICKERY AND JIM MATTHES/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE WHALE GALAXY** (NGC 4631) is a spiral galaxy that's being distorted by its small companion, elliptical galaxy NGC 4627. The Whale shines at magnitude 9.2.

MAP 7


14
17h
50°
16h
15h
Map 2
40°
17h 30°
20°
Map 8
Map 13
NGC 6229
M92
NGC 6207
M13
NGC 6058
NGC 5899
NGC 5676
NGC 5529
NGC 5466
NGC 5523
NGC 6210
NGC 6181
STT 289
Struve 1884
Abell 2065
Abell 2151
Seyfert's Sextet
NGC 5962
IC 4593
Arcturus
HERCULES
CORONA BOREALIS
BOÖTES
SERPENS CAPUT
τ
υ
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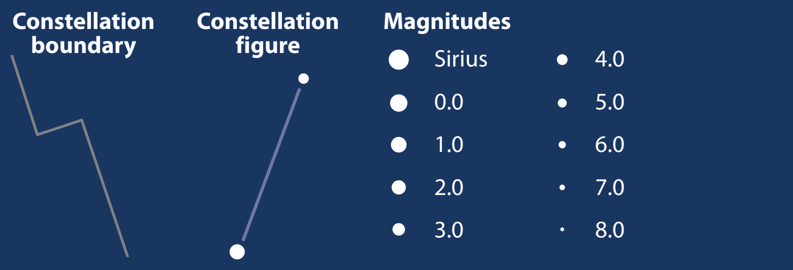
NORTH EQUATORIAL 4

This map is perfect as the sky darkens during spring in the Northern Hemisphere or autumn in the Southern Hemisphere.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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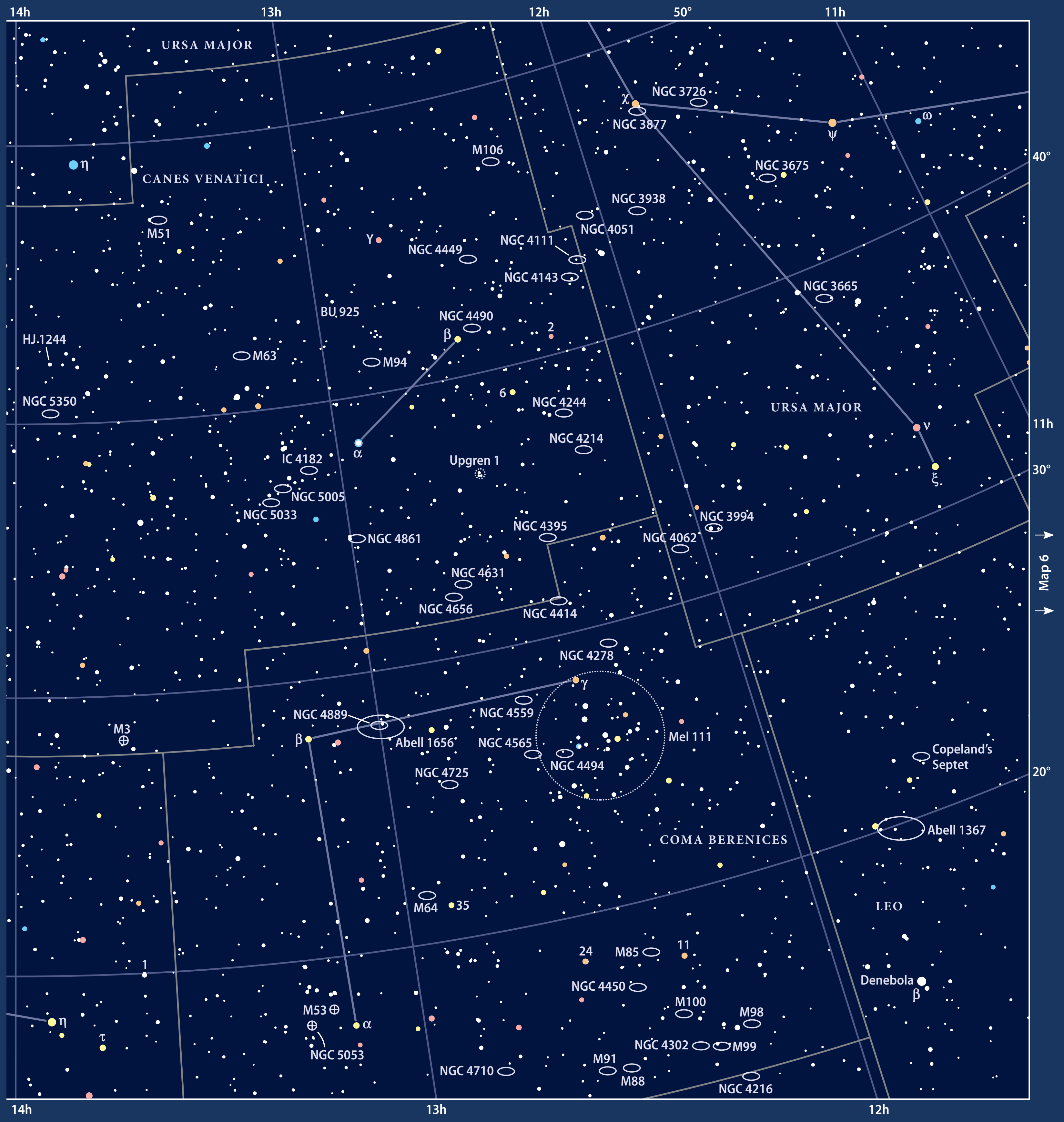
2.0
3.0
4.0
5.0
6.0
7.0
8.0


14h
13h
12h
50°
11h
URSA MAJOR
CANES VENATICI
NGC 3726
χ
NGC 3877
ψ
ω
M106
η
NGC 3675
40°
M51
NGC 3938
NGC 4051
Y
NGC 4449
NGC 4111
NGC 4143
NGC 3665
BU 925
NGC 4490
β
2
HJ 1244
M63
M94
NGC 5350
6
NGC 4244
URSA MAJOR
ν
11h
NGC 4214
α
IC 4182
Upgren 1
ξ
30°
NGC 5005
NGC 5033
NGC 3994
NGC 4395
NGC 4062
NGC 4861
Map 6
NGC 4631
NGC 4656
NGC 4414
NGC 4278
γ
M3
NGC 4889
NGC 4559
β
Abell 1656
NGC 4565
Mel 111
NGC 4494
Copeland's Septet
NGC 4725
20°
Abell 1367
COMA BERENICES
LEO
M64
35
24
M85
11
1
Denebola
β
NGC 4450
M100
M98
M53
η
α
τ
NGC 4302
M99
NGC 5053
M91
NGC 4710
M88
NGC 4216
14h
13h
12h

- ◌ Open cluster
- ⊕ Globular cluster
- □ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

TONY HALLAS

▲ **THE RING NEBULA (M57) in Lyra may be the sky's most-observed planetary nebula. This magnitude 8.8 object measures 1.4' by 1'.**

A showpiece globular

The constellations Hercules the Hero and Lyra the Harp are the two dominant star patterns on the following map. Denser regions of the Milky Way congregate in our galaxy's arms, preventing us from seeing much of what lies beyond. Instead, nearby star clusters and nebulae abound.

Starting in Hercules, find Pi, Eta, Zeta, and Epsilon Herculis — the Keystone of Hercules. Two-thirds of the way from Zeta to Eta, you'll find **M13**, the eighth brightest globular cluster in the sky. You can glimpse this magnitude 5.8 cluster without optical aid even from less-than-ideal locations. Any telescope pointed at M13 reveals a glorious swarm of stars. Through an 8-inch scope, you'll see more than 100. Increase the magnification beyond 150x, and try to spot the "propeller," the intersection of three dark lanes near the cluster's center.

Only slightly fainter than M13 is another globular cluster — magnitude 6.5 **M92**. This object lies on a nearly exact line between Iota and Eta Herculis. It's 5° from Iota and 7.6° from Eta.

Less than ½° northeast of M13 lies the magnitude 11.6 spiral galaxy **NGC 6207**. Insert an eyepiece that will give you a bit more than a half-degree field of view, and enjoy NGC 6207 and M13 at the same time.

Before you leave Hercules, check out **NGC 6210**, a small (25" by 15" in diameter) but bright (magnitude 8.8) planetary nebula. At magnifications under 100x, this object's color and uniform brightness are striking.

Midway between Alpha Aquilae and Beta Cygni lies Sagitta the Arrow. This star pattern ranks 86th out of the 88 constellations in size. It does contain a Messier object, however — **M71**. Glowing at 8th magnitude, M71 appears loosely arranged for a globular cluster. An 8-inch telescope resolves several dozen of the brightest stars set against a hazy background.

Because of its small size, parallelogram shape, and zero-magnitude star, Lyra the Harp is one of the easiest constellations to recognize. Two showpiece deep-sky objects reside there.

The **Double Double** (Epsilon Lyrae) is, as the name promises, a pair of double stars. Epsilon^1 is the northern and wider pair. The stars shine at magnitudes 5.0 and 6.1, and their separation is 2.6". The components of Epsilon^2 lie 2.3" from each other with each star glowing at magnitude 5.5. Even a small telescope at 100x will split both pairs.

The **Ring Nebula** (M57) is Lyra's other spectacle. A small scope reveals this object's doughnut shape. Move to a larger scope, and you'll notice the ring isn't exactly round but elongated roughly east-west. The darkened central area is easy to see, but the central star is a challenge object best left to telescopes 16 inches in aperture and larger.

THE CALDWELL OBJECTS

Amateur astronomers recognize M11, M20, and M31 as designations for deep-sky objects found on the list of 18th-century comet-hunter Charles Messier.

M11 is the Wild Duck Cluster in Scutum; M20 is the Trifid Nebula in Sagittarius; and M31 is the Andromeda Galaxy. But what if the letter C replaced the M in front of those numbers? Would you recognize C11, C20, and C31? This trio of deep-sky objects is also well-known, but perhaps not by these designations.

The C stands for Caldwell, or more specifically, for Caldwell-Moore, the full surname of well-known British astronomy popularizer Sir Patrick Moore. When it came time to place an identifier by each of the numbered objects on his list, he couldn't use M for Moore because Messier had taken that letter already, so he chose C. And in case you're still wondering, C11 is the Bubble Nebula (NGC 7635) in Cassiopeia, C20 is the North America Nebula (NGC 7000) in Cygnus, and C31 is the Flaming Star Nebula (IC 405) in Auriga.

Moore devised his list in 1995. Whereas Messier's list only includes objects visible from the latitude of Paris (48°51'), where Messier made his observations, Moore selected many southern objects. In fact, 34 Caldwell objects are invisible from Paris' latitude, and five others never climb more than 3° above the southern horizon there.

Relative to Messier's list, Moore slightly reduced the number of certain types of objects while increasing others. He reduced the number of star clusters and galaxies slightly, but he increased the number of nebulae. Only four planetary nebulae made Messier's list, but Moore selected 13. Likewise, Moore increased the number of bright nebulae from Messier's five to 12.

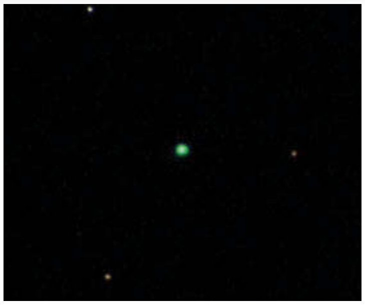
Sagittarius and Virgo, which have 15 and 11 Messier objects, respectively, have only one Caldwell object each. Cassiopeia, Centaurus, and Cygnus each contain six Caldwell objects — the most found in any constellation. Fifty of the 88 constellations contain Caldwell objects, as opposed to 34 that contain Messier ones.

Moore numbered the objects in his catalog by declination. He started in the northernmost region of the sky with C1 (NGC 188, an open cluster in Cepheus) and ended near the South Celestial Pole with C109 (NGC 3195, a planetary nebula in Chamaeleon).

Moore's final stipulation was that each of the Caldwell objects be observable through a 4-inch telescope from a dark location. In fact, you can observe many of the objects on Moore's list through binoculars, and some you can see with your unaided eyes. Others are more difficult to see, and although you can glimpse them through a 4-inch scope, you need a larger instrument to bring out their details.

DAMIAN PEACH

▲ **THE SKY'S GREATEST double star may be Albireo (Beta Cygni), which marks the Swan's head. The gold and sapphire-blue components easily separate in even the smallest telescope.**


CHRIS SCHUR

▲ **NGC 6210 is a planetary nebula in Hercules worth looking at with a low-power eyepiece. At magnifications around 50x, you won't see detail, but its color and uniform brightness will stand out.**

CALDWELL OBJECTS — PART 1

Caldwell no.	NGC no.	Constellation	Type	Magnitude	Map
1	188	Cepheus	OC	8.1	3
2	40	Cepheus	PN	11.6	3
3	4236	Draco	Gal	9.7	2
4	7023	Cepheus	N	6.8	3
5	IC 342	Camelopardalis	Gal	9.2	1
6	6543	Draco	PN	8.8	3
7	2403	Camelopardalis	Gal	8.9	1
8	559	Cassiopeia	OC	9.5	1
9	Sh2–155	Cepheus	N	7.7	3
10	663	Cassiopeia	OC	7.1	1
11	7635	Cassiopeia	N	7.0	3
12	6946	Cepheus	Gal	9.7	3
13	457	Cassiopeia	OC	6.4	1
14	869/884	Perseus	OC	4.3	1
15	6826	Cygnus	PN	9.8	8
16	7243	Lacerta	OC	6.4	9
17	147	Cassiopeia	Gal	9.3	4
18	185	Cassiopeia	Gal	9.2	4
19	IC 5146	Cygnus	N	10.0	9
20	7000	Cygnus	N	6.0	9
21	4449	Canes Venatici	Gal	9.4	7
22	7662	Andromeda	PN	9.2	9
23	891	Andromeda	Gal	9.9	4
24	1275	Perseus	Gal	11.6	4
25	2419	Lynx	GC	10.4	5
26	4244	Canes Venatici	Gal	10.6	7
27	6888	Cygnus	N	7.5	9
28	752	Andromeda	OC	5.7	4
29	5005	Canes Venatici	Gal	9.8	7
30	7331	Pegasus	Gal	9.5	9
31	IC 405	Auriga	N	6.0	5
32	4631	Canes Venatici	Gal	9.3	7
33	6992/5	Cygnus	SNR	—	9
34	6960	Cygnus	SNR	—	9
35	4889	Coma Berenices	Gal	11.4	7
36	4559	Coma Berenices	Gal	9.8	7
37	6885	Vulpecula	OC	5.7	9
38	4565	Coma Berenices	Gal	9.6	7
39	2392	Gemini	PN	9.9	5
40	3626	Leo	Gal	10.9	6
41	Hyades	Taurus	OC	1.0	11
42	7006	Delphinus	GC	10.6	15
43	7814	Pegasus	Gal	10.5	10
44	7479	Pegasus	Gal	11.0	15
45	5248	Boötes	Gal	10.2	13
46	2261	Monoceros	N	10.0	11
47	6934	Delphinus	GC	8.9	15
48	2775	Cancer	Gal	10.3	12
49	2237–9	Monoceros	N	—	11
50	2244	Monoceros	OC	4.8	11
51	IC 1613	Cetus	Gal	9.0	10
52	4697	Virgo	Gal	9.3	13
53	3115	Sextans	Gal	9.1	12
54	2506	Monoceros	OC	7.6	12

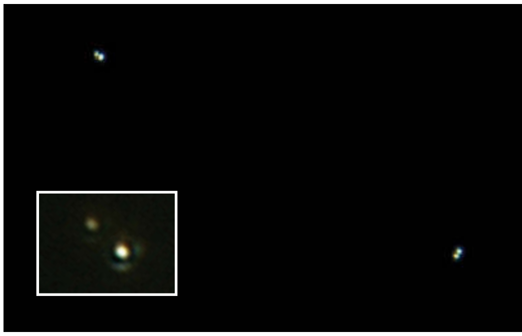
KEY:
Gal = Galaxy
GC = Globular cluster
N = Nebula
OC = Open cluster
PN = Planetary nebula
SNR = Supernova remnant

Continued on page 37

▲ **THE HERCULES CLUSTER** (M13) is a beautiful small-telescope target. At magnitude 5.8, it's a naked-eye object when viewed from a dark site. R. JAY GABANY

CHRIS SCHUR

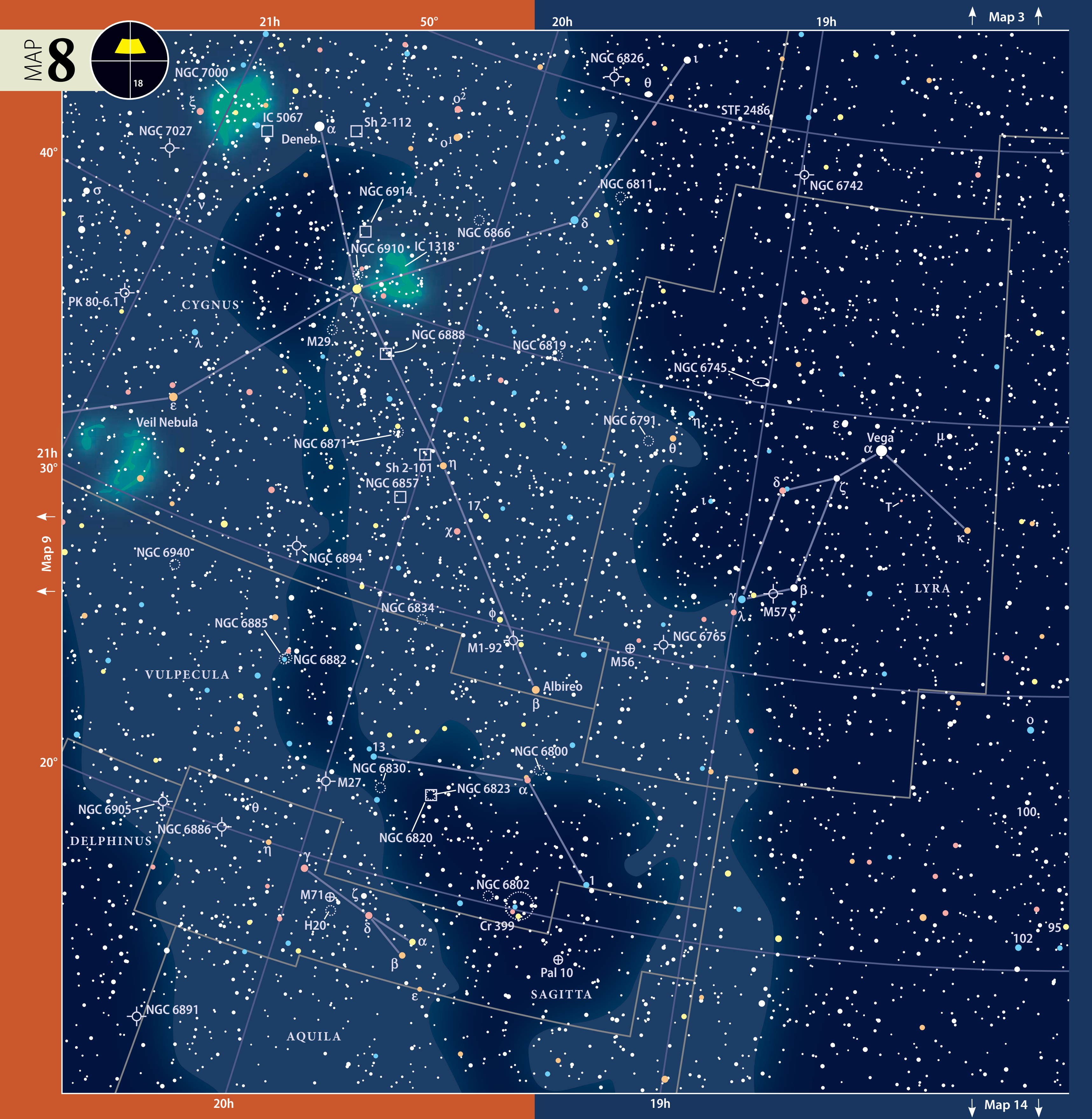
▲ **M92 IN HERCULES** is that constellation's "forgotten" globular cluster because so many observers concentrate their time on M13. Do yourself a favor, however, and don't overlook this magnitude 6.5 gem.



▲ **THE DOUBLE DOUBLE** (Epsilon Lyrae) offers a rewarding pair of targets. Use low power to see both sets in the same field of view. The inset image shows Epsilon^2 Lyrae. DAMIAN PEACH

DOUBLE-STAR DELIGHTS — MAP 8

Designation	Right ascension	Declination	Magnitudes	Separation
Kappa Herculis	16h08m	17°03'	5.3, 6.5	28.1"
Omega Herculis	16h25m	14°02'	4.5, 11.0	28.4"
52 Herculis	16h49m	45°59'	4.9, 10.4	1.8"
HO 412	17h08m	35°56'	5.4, 11.4	20.0"
Delta Herculis	17h15m	24°50'	3.2, 8.3	9.5"
Rho Herculis	17h24m	37°08'	4.5, 5.5	4.1"
95 Herculis	18h01m	21°35'	5.1, 5.2	6.3"
100 Herculis	18h08m	26°05'	5.9, 6.0	14.2"
102 Herculis	18h09m	20°49'	4.3, 11.8	23.4"
Nu^2 Lyrae	18h50m	32°33'	5.2, 12.7	19.0"
Gamma Lyrae	18h59m	32°41'	3.3, 12.1	13.4"
STF 2486	19h12m	49°50'	6.6, 6.8	7.9"
Eta Lyrae	19h14m	39°12'	4.0, 8.0	28.0"
Theta Cygni	19h37m	50°12'	4.6, 12.9	3.2"
17 Cygni	19h46m	33°44'	5.0, 9.2	26.0"
Zeta Sagittae	19h49m	19°06'	5.5, 9.0	8.0"
Eta Cygni	19h56m	35°05'	4.0, 12.0	7.4"
Theta Sagittae	20h10m	20°54'	6.4, 8.9	12.0"


MAP 8
18
21h
50°
20h
19h
Map 3
NGC 7000
NGC 7027
IC 5067
Deneb
α
Sh 2-112
ο²
ο¹
ξ
NGC 6826
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STF 2486
NGC 6742
NGC 6811
40°
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NGC 6914
NGC 6866
δ
NGC 6910
IC 1318
PK 80-6.1
CYGNUS
γ
λ
M29
NGC 6888
NGC 6819
NGC 6745
ε
Veil Nebula
NGC 6791
η
θ
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Vega
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21h
30°
NGC 6871
Sh 2-101
η
NGC 6857
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Map 9
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NGC 6940
NGC 6894
NGC 6834
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LYRA
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M57
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NGC 6885
M1-92
NGC 6765
M56
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13
NGC 6800
NGC 6830
M27
NGC 6823
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NGC 6905
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NGC 6886
NGC 6820
DELPHINUS
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γ
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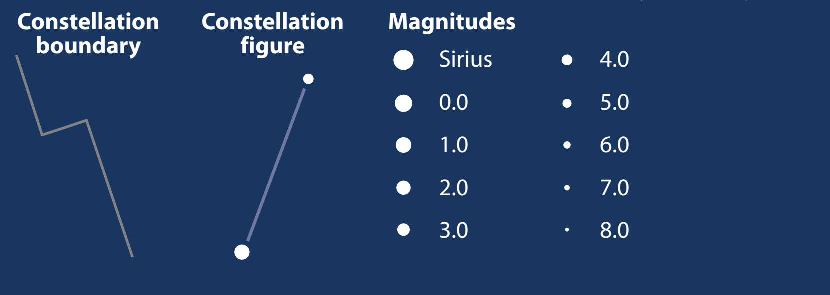
NGC 6802
M71
ζ
H20
δ
Cr 399
α
95
102
β
Pal 10
ε
SAGITTA
NGC 6891
AQUILA
20h
19h
Map 14

NORTH EQUATORIAL 5

Use this map on early summer evenings in the Northern Hemisphere and on early winter evenings south of the equator.


Constellation boundary
Constellation figure
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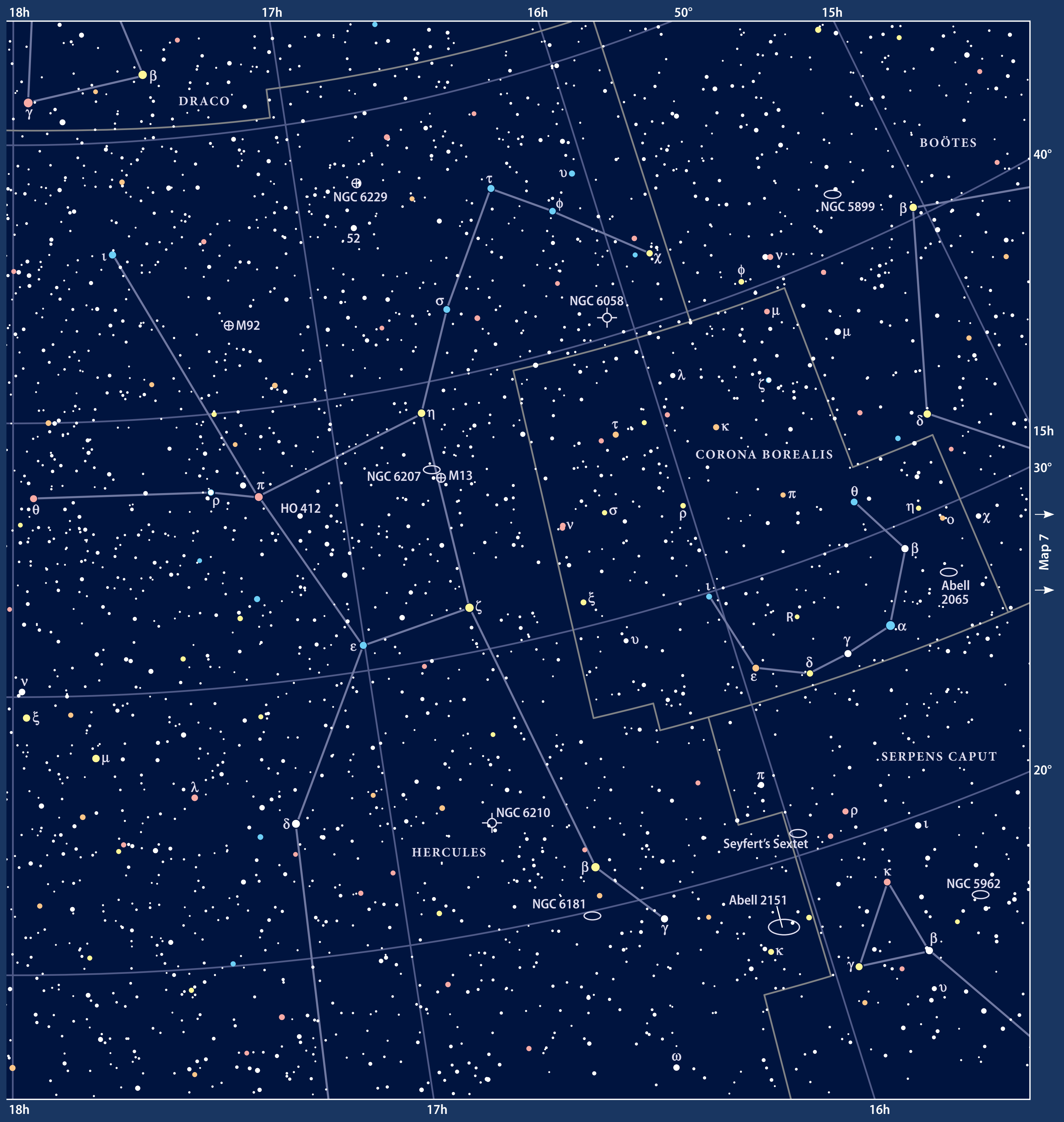
2.0
3.0
4.0
5.0
6.0
7.0
8.0


18h
17h
16h
50°
15h
40°
15h
30°
20°
Map 7
18h
17h
16h
DRACO
BOÖTES
CORONA BOREALIS
SERPENS CAPUT
HERCULES
NGC 6229
52
M92
NGC 6058
NGC 5899
NGC 6207
M13
HO 412
Abell 2065
NGC 6210
Seyfert's Sextet
NGC 5962
Abell 2151
NGC 6181
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◌	Open cluster
⊕	Globular cluster
□	Diffuse nebula
⌖	Planetary nebula
⬭	Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

DANIEL B. PHILLIPS

▲ **THE VEIL NEBULA (NGC 6992/5) represents a magnificent supernova remnant complex in Cygnus the Swan. This object stretches across more than 3° of sky, so use low power to observe it and scan all around.**

Flying with the Swan

The next map shows the stars corresponding to autumn in the Northern Hemisphere. The eastern regions of Cygnus the Swan and the northern part of Pegasus the Winged Horse dominate the chart. Cygnus lies along the Milky Way and contains a vast number of clusters and nebulae.

Start 3° east of Deneb (Alpha Cygni) and locate the **North America Nebula** (NGC 7000). Many observers can see this object's outline even without binoculars, but others require help. It's big (2° by 1⅔°), so use binoculars or a wide-field view through a telescope to attack it. If you're still having trouble, use either a nebula filter or a more restrictive OIII filter. Some observers report positive results by hand-holding the filter and not using a telescope at all.

If you have an OIII filter, observe the **Veil Nebula** (NGC 6992/5). The Veil is the remnant of a supernova that exploded 30,000 years ago. It lies 2,500 light-years away and measures an immense 2.7° by 3.8°. Approach this object in two ways. You can try to capture all of it in one view, but you'll need an eyepiece/telescope combination yielding a 4° field. While you'll capture it, you won't see much detail. To get a clearer view, use an eyepiece (plus OIII filter) in the 50x to 75x range and scan the Veil by moving your scope to follow its full extent.

On Map 3, about 1½° east-northeast of Theta Cygni lies the **Blinking Planetary** (NGC 6826). Through small scopes, you'll see the central star if you look at NGC 6826 using direct vision. Look a bit away from the central star with "averted vision," and it will be swallowed in the planetary's nebulosity. So, look directly at — and then away from — the star to "blink" the planetary. Use a small scope to try this because telescopes larger than 6 inches keep the central star visible at all times.

Fall in the Northern Hemisphere often is called "planetary season" because of the large number of planetary nebulae visible. Magnitude 10.7 **NGC 7008** (also on Map 3) lies in a region devoid of bright stars. NGC 7008 lies almost 10° north of Deneb and measures 83" across.

For a new perspective on planetary nebulae, turn your scope toward the **Dumbbell Nebula** (M27) in Vulpecula. M27 is one of the largest and brightest (magnitude 7.3) planetaries in the sky, mostly because of its distance, a scant 800 light-years. Binoculars reveal this object, and a small telescope shows its lobes (the ends of the dumbbell). Through a 12-inch or larger scope, you'll see irregularities in M27's surface and thin, faint arcs at both lobe ends. More than a dozen faint stars lie superimposed over the Dumbbell, which measures about 6' across.

As we've progressed through the past few star maps, we've also moved farther from the Milky Way, so more galaxies are visible. Start with magnitude 9.5 spiral galaxy **NGC 7331**, which lies 4.3° north-northwest of Eta Pegasi. This galaxy is part of a group that numbers less than a dozen. Use a low-power eyepiece through a 10-inch scope to see several other members. The galaxy is 10.5' long and a third as wide. The bright, elongated central region washes out the fainter spiral arms through telescopes less than 12 inches in aperture.

Finally, if you have access to a large scope, train it on **Stephan's Quintet** (NGC 7317, NGC 7318A, NGC 7318B, NGC 7319, and NGC 7320), a collection of galaxies ½° southwest of NGC 7331. In the quintet, NGC 7320 is the brightest, glowing meekly at magnitude 12.5. The faintest, NGC 7317, shines 13 times fainter at magnitude 15.3.

/// DOUBLE-STAR DELIGHTS — MAP 9

Designation	Right ascension	Declination	Magnitudes	Separation
Gamma Delphini	20h47m	16°08'	4.5, 5.5	9.6"
Kappa Pegasi	21h45m	25°36'	4.5, 10.0	14.0"
STF 2841	21h54m	19°43'	6.5, 8.0	22.3"
Iota Pegasi	22h07m	25°21'	4.0, 11.4	3.7"
STF 2894	22h19m	37°46'	6.2, 8.4	15.6"
STF 2906	22h27m	37°26'	6.4, 10.0	4.4"
8 Lacertae	22h36m	39°38'	6.6, 6.8	22.4"
13 Lacertae	22h44m	41°48'	5.2, 10.6	14.6"
15 Lacertae	22h52m	43°17'	5.2, 12.2	25.7"
Beta Pegasi	23h04m	28°04'	2.6, 11.8	8.5"
75 Pegasi	23h38m	18°24'	5.4, 11.6	27.7"

SÁNDOR BRASKÓ

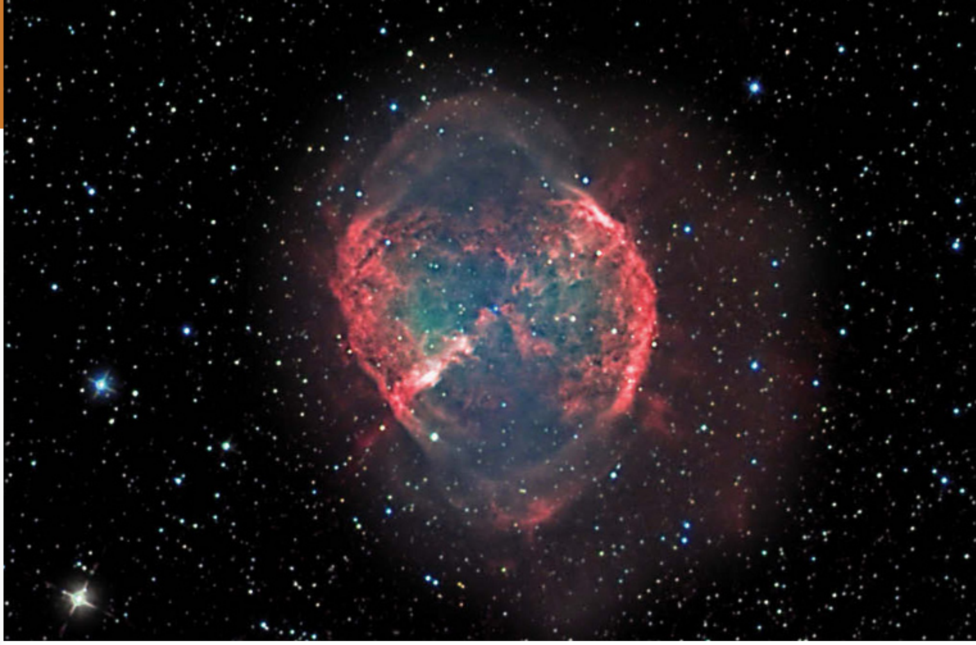
▲ **THE NORTH AMERICA NEBULA (NGC 7000) in Cygnus measures 2° across. Can you see this object, which lies near Deneb (Alpha Cygni), with your unaided eyes? If not, try looking through a nebula filter.**

/// CALDWELL OBJECTS — PART 2

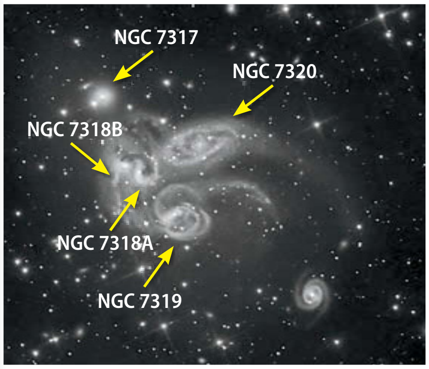
Continued from page 33

Caldwell no.	NGC no.	Constellation	Type	Magnitude	Map
55	7009	Aquarius	PN	8.3	15
56	246	Cetus	PN	8.0	10
57	6822	Sagittarius	Gal	9.3	14
58	2360	Canis Major	OC	7.2	11
59	3242	Hydra	PN	8.6	18
60	4038	Corvus	Gal	11.3	19
61	4039	Corvus	Gal	13.0	19
62	247	Cetus	Gal	8.9	16
63	7293	Aquarius	PN	6.5	21
64	2362	Canis Major	OC	4.1	17
65	253	Sculptor	Gal	7.1	16
66	5694	Hydra	GC	10.2	19
67	1097	Fornax	Gal	9.2	16
68	6729	Corona Australis	N	9.7	20
69	6302	Scorpius	PN	12.8	20
70	300	Sculptor	Gal	8.1	16
71	2477	Puppis	OC	5.8	17
72	55	Sculptor	Gal	8.2	16
73	1851	Columba	GC	7.3	17
74	3132	Vela	PN	8.2	18
75	6124	Scorpius	OC	5.8	20
76	6231	Scorpius	OC	2.6	20
77	5128	Centaurus	Gal	7.0	19
78	6541	Corona Australis	GC	6.6	20
79	3201	Vela	GC	6.7	18
80	5139	Centaurus	GC	3.6	19
81	6352	Ara	GC	8.1	20
82	6193	Ara	OC	5.2	20
83	4945	Centaurus	Gal	9.5	19
84	5286	Centaurus	GC	7.6	19
85	IC 2391	Vela	OC	2.5	23
86	6397	Ara	GC	5.6	24
87	1261	Horologium	GC	8.4	22
88	5823	Circinus	OC	7.9	23
89	6087	Norma	OC	5.4	23
90	2867	Carina	PN	9.7	23
91	3532	Carina	OC	3.0	23
92	3372	Carina	N	6.2	23
93	6752	Pavo	GC	5.4	24
94	4755	Crux	OC	4.2	23
95	6025	Triangulum Australe	OC	5.1	23
96	2516	Carina	OC	3.8	22
97	3766	Centaurus	OC	5.3	23
98	4609	Crux	OC	6.9	23
99	Coal Sack	Crux	DN	—	23
100	IC 2944	Centaurus	N	4.5	23
101	6744	Pavo	Gal	9.0	24
102	IC 2602	Carina	OC	1.9	23
103	2070	Dorado	N	1.0	22
104	362	Tucana	GC	6.6	24
105	4833	Musca	GC	7.3	23
106	104	Tucana	GC	4.0	24
107	6101	Apus	GC	9.3	23
108	4372	Musca	GC	7.8	23
109	3195	Chamaeleon	PN	—	23

KEY:
DN = Dark nebula
Gal = Galaxy
GC = Globular cluster
N = Nebula
OC = Open cluster
PN = Planetary nebula
SNR = Supernova remnant

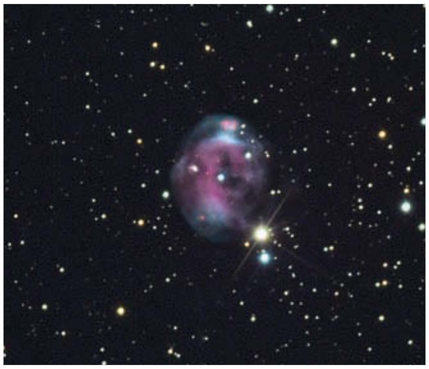


▲ **THE DUMBBELL NEBULA** (M27) in Vulpecula the Fox is one of the largest and closest planetary nebulae. You'll see this magnitude 7.3 object easily through small telescopes (or even binoculars), but it appears spectacular through large ones. WOLFGANG PROMPER



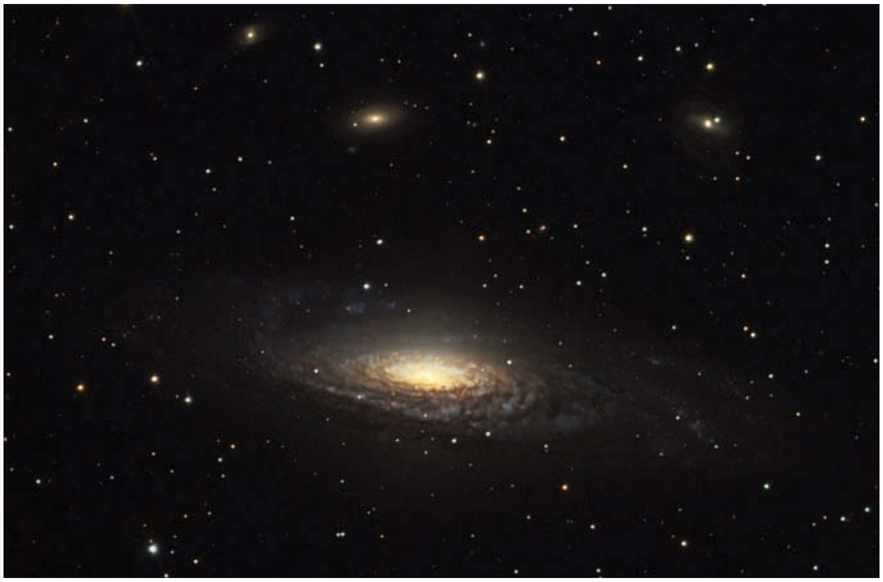
TONY HALLAS

▲ **STEPHAN'S QUINTET** is a group of five galaxies in Pegasus. You can spot all five through a 12-inch telescope, but to see details in these objects, you'll need to use a 20-inch or larger scope. At magnitude 12.5, NGC 7320 shines brightest.



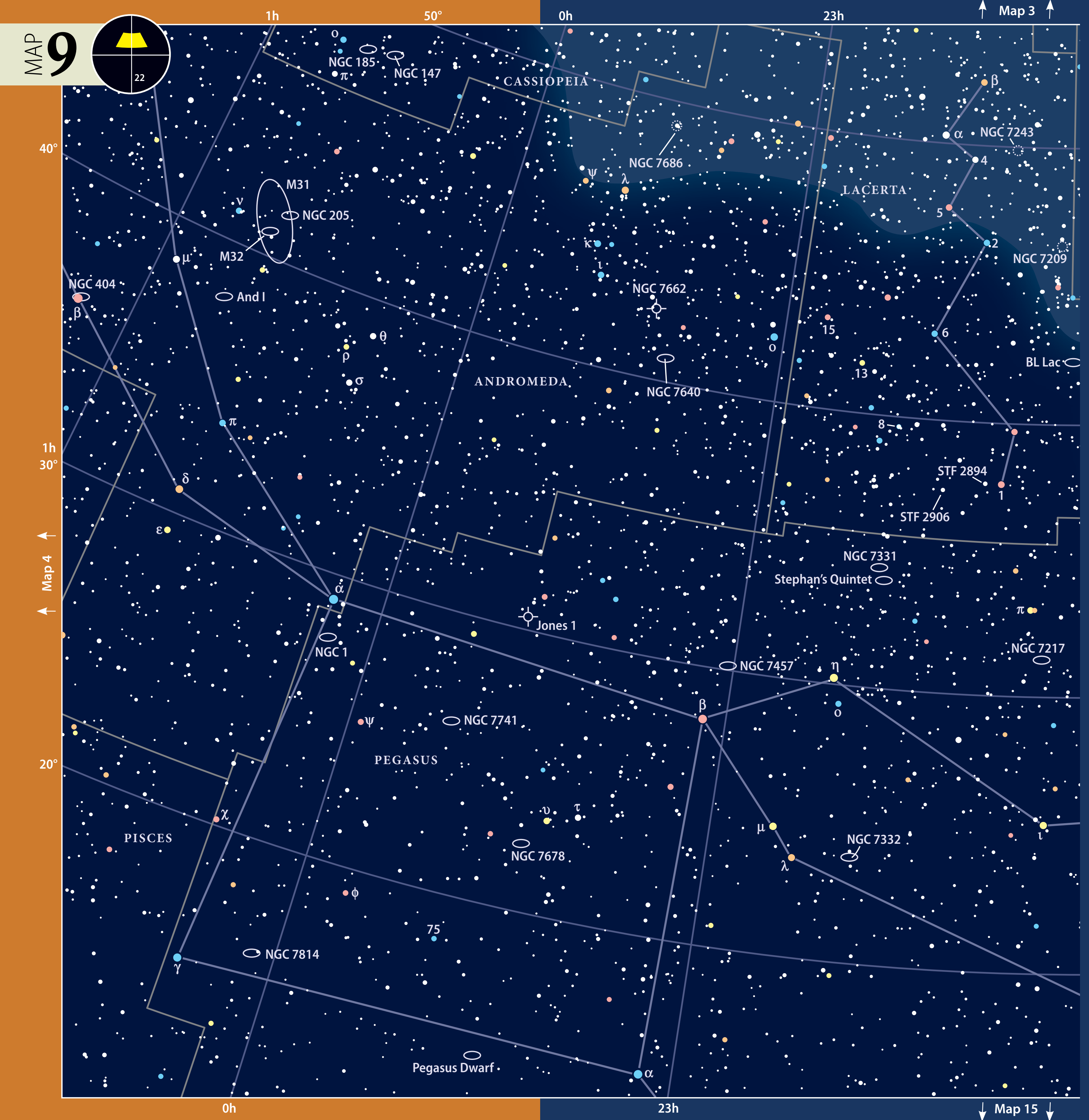
DONN AND AARON STARKEY/ADAM BLOCK/NOAO/AURA/NSF

▲ **PLANETARY NEBULA** NGC 7008 (Map 3) in Cygnus shines at magnitude 10.7. Through a medium-sized telescope, this object looks like an irregular broken ring. You'll need a 12-inch or larger scope to see any color, however.



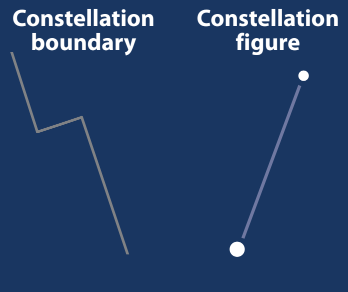
LOUIS AND JENNIFER GOLDRING/ADAM BLOCK/NOAO/AURA/NSF

▲ **SPIRAL GALAXY** NGC 7331 in Pegasus is one of the brightest galaxies not in Messier's catalog. It shines at magnitude 9.5. Some half dozen galaxies accompany NGC 7331.


MAP 9
22
1h
50°
0h
23h
Map 3
40°
1h
30°
Map 4
20°
0h
23h
Map 15
o
NGC 185
π
NGC 147
CASSIOPEIA
NGC 7686
ψ
λ
β
α
NGC 7243
4
LACERTA
5
2
NGC 7209
M31
ν
NGC 205
M32
μ
κ
ι
NGC 404
β
And I
NGC 7662
15
o
6
θ
ρ
σ
13
BL Lac
ANDROMEDA
NGC 7640
π
8
STF 2894
1
STF 2906
δ
ε
NGC 7331
Stephan's Quintet
α
Jones 1
π
NGC 1
NGC 7217
NGC 7457
η
β
o
ψ
NGC 7741
PEGASUS
υ
τ
χ
μ
NGC 7332
PISCES
NGC 7678
ι
λ
φ
75
NGC 7814
γ
Pegasus Dwarf
α

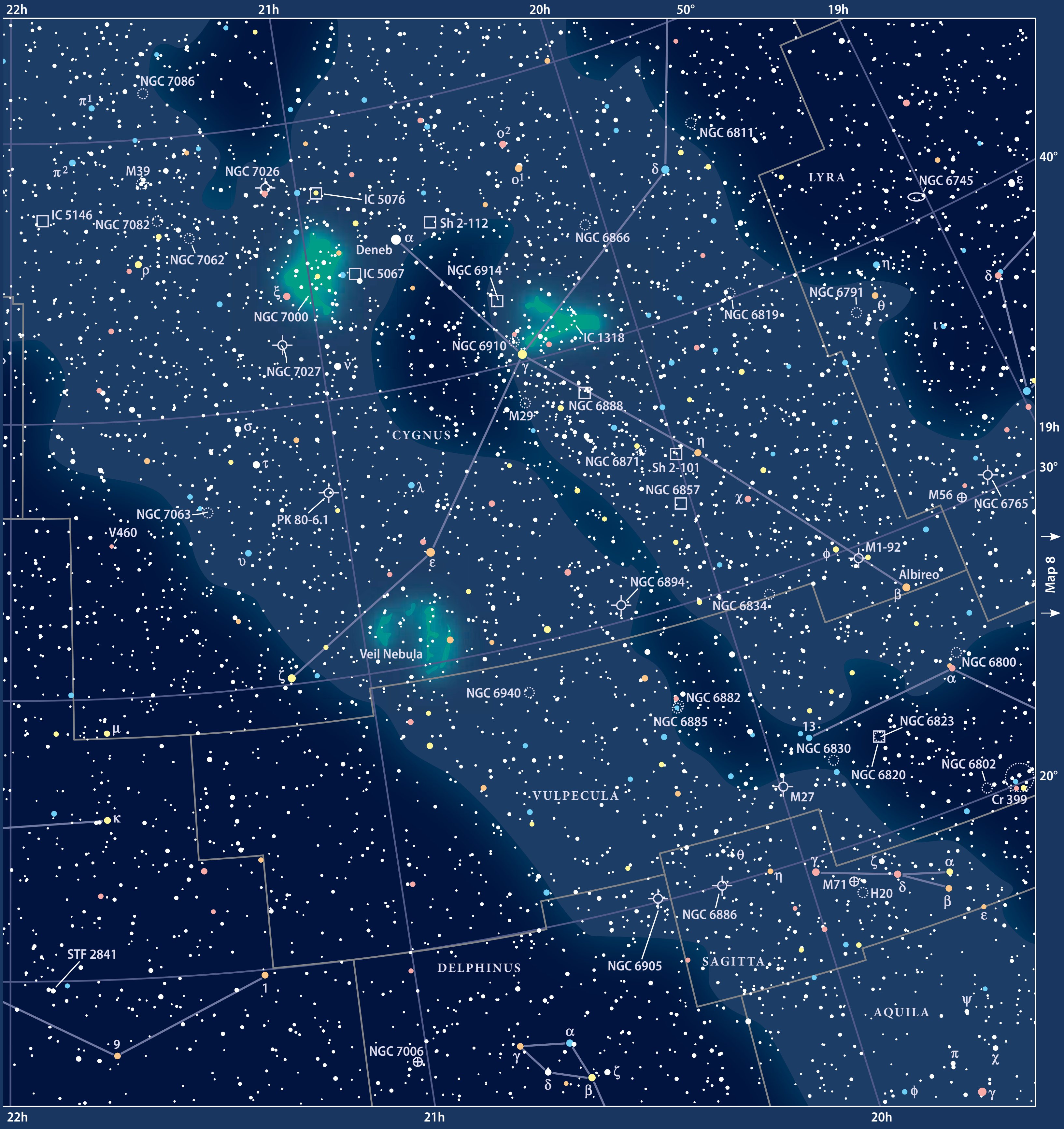
NORTH EQUATORIAL 6

View the objects on this map in the early evening during late summer in the Northern Hemisphere and late winter south of the equator.


Constellation boundary
Constellation figure

Magnitudes

●	Sirius	•	4.0
●	0.0	•	5.0
●	1.0	•	6.0
●	2.0	·	7.0
●	3.0	·	8.0


22h
21h
20h
50°
19h
40°
19h
30°
20°
20h
21h
22h
Map 8
CYGNUS
LYRA
VULPECULA
SAGITTA
DELPHINUS
AQUILA
NGC 7086
π1
π2
M39
NGC 7026
IC 5076
IC 5146
NGC 7082
NGC 7062
ρ
Sh 2-112
α
Deneb
IC 5067
ξ
NGC 7000
NGC 7027
ν
NGC 6914
NGC 6910
IC 1318
γ
o2
o1
δ
NGC 6811
NGC 6866
NGC 6819
NGC 6791
NGC 6745
ε
η
θ
ι
δ
NGC 6888
M29
σ
τ
NGC 6871
Sh 2-101
η
NGC 6857
χ
λ
PK 80-6.1
NGC 7063
V460
υ
ε
M56
NGC 6765
M1-92
φ
Albireo
β
NGC 6894
NGC 6834
Veil Nebula
ζ
NGC 6940
NGC 6882
NGC 6885
NGC 6800
α
μ
13
NGC 6830
NGC 6823
NGC 6820
NGC 6802
Cr 399
M27
κ
θ
η
γ
ζ
α
δ
β
M71
H20
NGC 6886
NGC 6905
ε
STF 2841
1
9
NGC 7006
α
γ
δ
β
ζ
ψ
π
χ
φ
γ

◌ Open cluster
⊕ Globular cluster
□ Diffuse nebula
-○- Planetary nebula
⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

MAP 10 EQUATORIAL REGION 1

▲ **SPIRAL GALAXY** **M74 in Pisces is the prototypical face-on spiral. It glows at magnitude 8.5 and lies 35 million light-years away.** DANIEL VERSCHATSE

An ocean of galaxies

Two large but faint constellations dominate the first equatorial star chart — Cetus the Whale and Pisces the Fish. Lots of galaxies populate this region, which lies far from the Milky Way. Charles Messier pinpointed only one object in each of these giant constellations, but a patient observer equipped with an 8-inch or larger telescope under a dark sky will see much more than two bright galaxies.

We'll start with an object that's not a galaxy — planetary nebula **NGC 246**. To find it, make an equal-sided triangle with Phi^1 and Phi^2 Ceti. You'll see the nebula through small telescopes, but this magnitude 10.9 object's details start to emerge only through 6-inch or larger instruments. Double the aperture to 12 inches, and you'll see the planetary's bright northeast rim and five superimposed stars. Add a nebula filter, and NGC 246's irregular inner structure will jump out at you.

Follow NGC 246 with — what else? — **NGC 247** (9° south, on Map 16). The given brightness of this galaxy, magnitude 8.8, is deceptive. Because NGC 247 measures 20' by 7', its light spreads over a larger area than most galaxies'. Its low surface brightness makes it a target for larger scopes, although you can glimpse it through a 3-inch under a dark sky.

With a 12-inch or larger telescope at a dark site, you can spot **IC 1613**, which lies about 1° north-northeast of 26 Ceti. IC 1613 is another low-surface-brightness galaxy, but it's worth finding because it belongs to the Local Group. Use a wide-field eyepiece under a dark sky to scan for this magnitude 9.2 irregular galaxy. Look for a fairly large (20' across) brightening of the sky background.

FLAMSTEED'S CATALOG NUMBERS

Throughout this atlas, certain stars on the charts and in the "Double-star delights" lists have numbers followed by the possessive forms of constellation names. Examples are 61 Cygni and 100 Herculis.

Such designations trace their roots to a catalog of stars by English astronomer John Flamsteed (1646–1719). The catalog, *Historia Coelestis Britannica* (1725), the third volume of Flamsteed's observations, contains approximately 3,000 stars.

Actually, Flamsteed did not number stars. Astronomer Joseph Jerome de Lalande (1732–1807) added the numbers in a French edition of Flamsteed's catalog. Because Lalande used Flamsteed's catalog as his resource, we call the designations Flamsteed numbers.

The showpiece object in Cetus is its sole Messier object: **M77**. This magnitude 8.9 spiral galaxy lies less than 1° east-southeast of Delta Ceti. Through a 4-inch telescope, the core of M77 appears starlike with a wispy halo. Because the halo is denser to the northwest, the galaxy has a vague comet-like appearance. An 8-inch or larger scope reveals structure in the central 2' of this 8' by 7' galaxy, but you'll need at least 12 inches of aperture to resolve the closely wound spiral arms. A magnitude 10 star glows 1.5' to the east-southeast.

Almost exactly 0.5° north-northwest of M77 lies the equally beautiful edge-on spiral **NGC 1055**. You'll see both galaxies in any eyepiece that shows you the entire Full Moon, and they're quite a sight through a large telescope. Through a 6-inch scope, you'll see NGC 1055 as a 4' by 1' spindle aligned east-west. Increase your aperture to 10 inches, and you'll notice the dust lane that cuts this galaxy in two lengthwise. The dark lane's northern edge is easiest to spot.

Hop north to Aries, and a bit more than 1° east of Gamma Arietis (a great double star) to find spiral galaxy **NGC 772**. This magnitude 10.3 object is more than 50 percent longer than it is wide (7.3' by 4.6'). Astronomers classify NGC 772 as a peculiar galaxy, mainly due to its gravitational interaction with NGC 770. You easily can see the nucleus of NGC 770 just off the southern edge of NGC 772's halo.

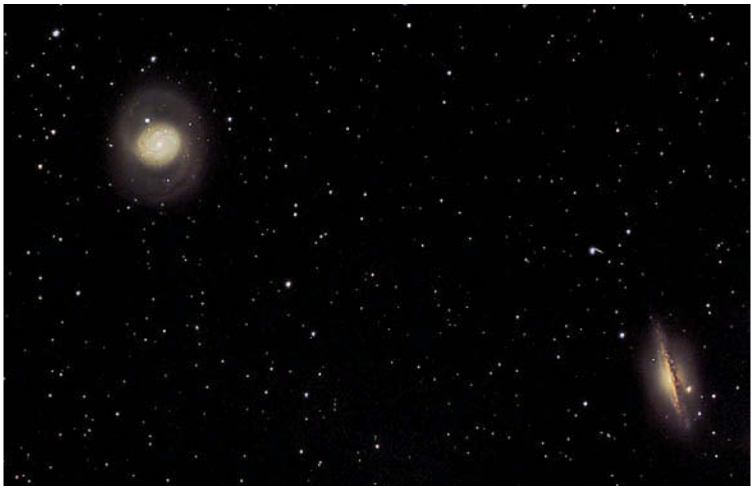
Aries also is home to a small galaxy group. The brightest member is **NGC 877**, a magnitude 11.9 barred spiral. Use at least a 12-inch telescope to see it and its fainter companions: NGC 876 lies to the southwest, and NGC 871, the brightest of several dim galaxies, is east of NGC 877.

In Eridanus the River, **NGC 1300** deserves your attention. This barred spiral galaxy lies 2° north of Tau^4 Eridani and glows at magnitude 10.4. The galaxy's nucleus stands out nicely. Next, in order of visual prominence, are the two nodules at the ends of the bar. Most difficult to see are NGC 1300's spiral arms, which wind tightly around the inner parts.

Look a bit more than 1.5° southwest of Pi Eridani for peculiar galaxy **NGC 1421**. Barely visible through a 6-inch telescope, NGC 1421 shows lots of detail through a 10-inch or larger scope. It appears spindle-like (3' by 0.5') with its long axis aligned north-south. Crank up the power, and you'll see irregular structure in the form of several knotty regions. The core, which stretches 1', appears brighter on its northern end.

Moving to Pisces, look slightly more than 2° southwest of Mu Piscium for spiral galaxy **NGC 488**. The outer regions of this magnitude 10.3 object are difficult to see, but the central 1' is bright and gets brighter toward the core. NGC 488 measures 5.4' by 3.9'.

Spiral galaxy **NGC 676** shines at 10th magnitude, or maybe 11th. The uncertainty comes from a magnitude 9.5 star positioned in front of the


DANIEL VERSCHATSE

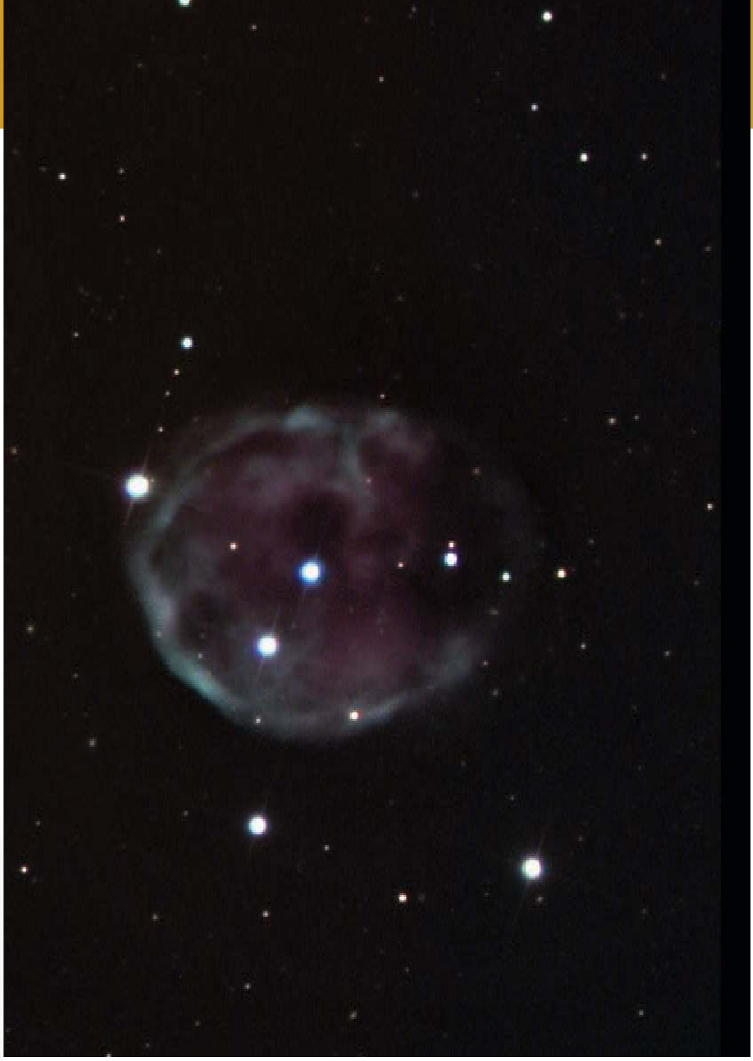
▲ **M77 (UPPER LEFT) and NGC 1055 exemplify face-on and edge-on spiral galaxies, respectively. Both lie about 70 million light-years away in Cetus.**

DOUBLE-STAR DELIGHTS — MAP 10

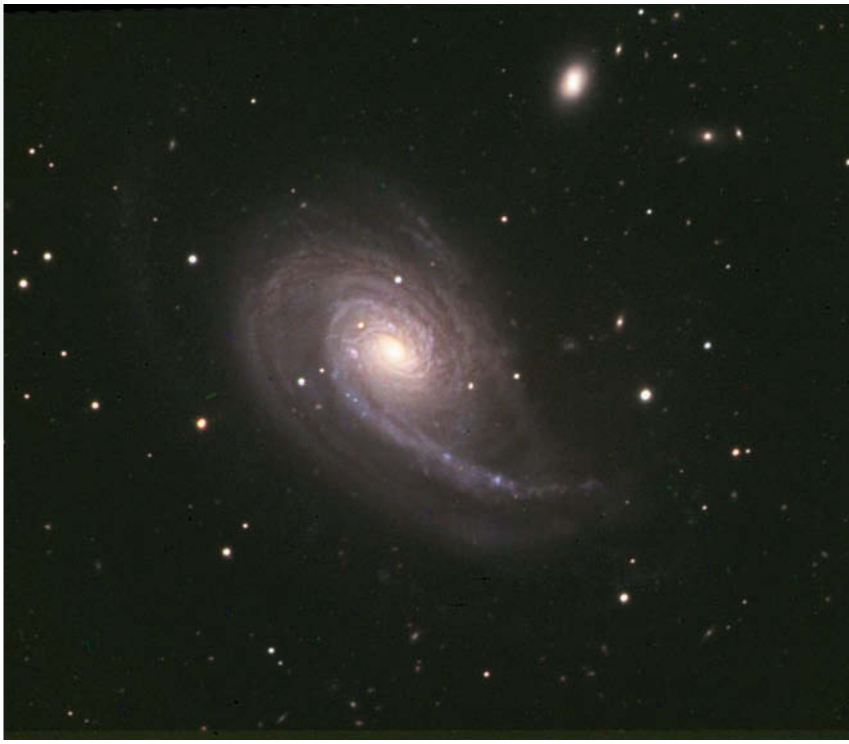
Designation	Right ascension	Declination	Magnitudes	Separation
34 Piscium	0h10m	11°08'	5.5, 10.0	7.7"
51 Piscium	0h32m	6°57'	5.7, 9.7	27.5"
Zeta Piscium	1h14m	7°34'	5.6, 6.5	23.0"
HJ 2043	1h23m	–19°04'	6.5, 8.8	5.0"
STT 31	1h33m	8°12'	6.6, 10.7	4.2"
GAL 315	1h57m	–10°16'	6.7, 10.4	29.6"
66 Ceti	2h13m	–2°23'	5.8, 7.6	16.5"
Nu Ceti	2h36m	5°35'	5.0, 9.6	8.1"
84 Ceti	2h41m	–0°41'	5.8, 9.0	4.1"
RST 4223	3h07m	–6°04'	5.6, 12.8	15.9"
94 Ceti	3h13m	–1°11'	5.1, 11.5	3.2"
AG 68	3h32m	11°32'	6.9, 10.1	17.6"
30 Eridani	3h53m	–5°22'	5.5, 10.6	8.2"
32 Eridani	3h54m	–2°57'	5.0, 6.3	6.8"
39 Eridani	4h14m	–10°14'	5.2, 8.2	6.4"
Omicron^2 Eridani	4h16m	–7°34'	4.5, 12.5	11.0"

galaxy's nucleus. The star is bright enough that you'll have trouble seeing the galaxy through a 6-inch telescope. Through a 12-inch, however, you'll see NGC 676 as lens-shaped, measuring 3' by 1' and aligned roughly north-south. Look for NGC 676 roughly 2° east-northeast of Nu Piscium.

The great face-on spiral galaxy **M74** is Pisces' highlight object. Find it 1.3° east-northeast of Eta Piscium. M74 extends 10' in diameter, so its magnitude 8.5 brightness spreads out a lot. Even a 2.4-inch telescope shows half the galaxy's extent, but a large scope (12 inches and above) reveals both stellar associations and gas clouds. The core is broad — 2.5' across — and condensed. Adding to M74's appearance, six stars lie in our line of sight to this galaxy, two of them superimposed on its nucleus.

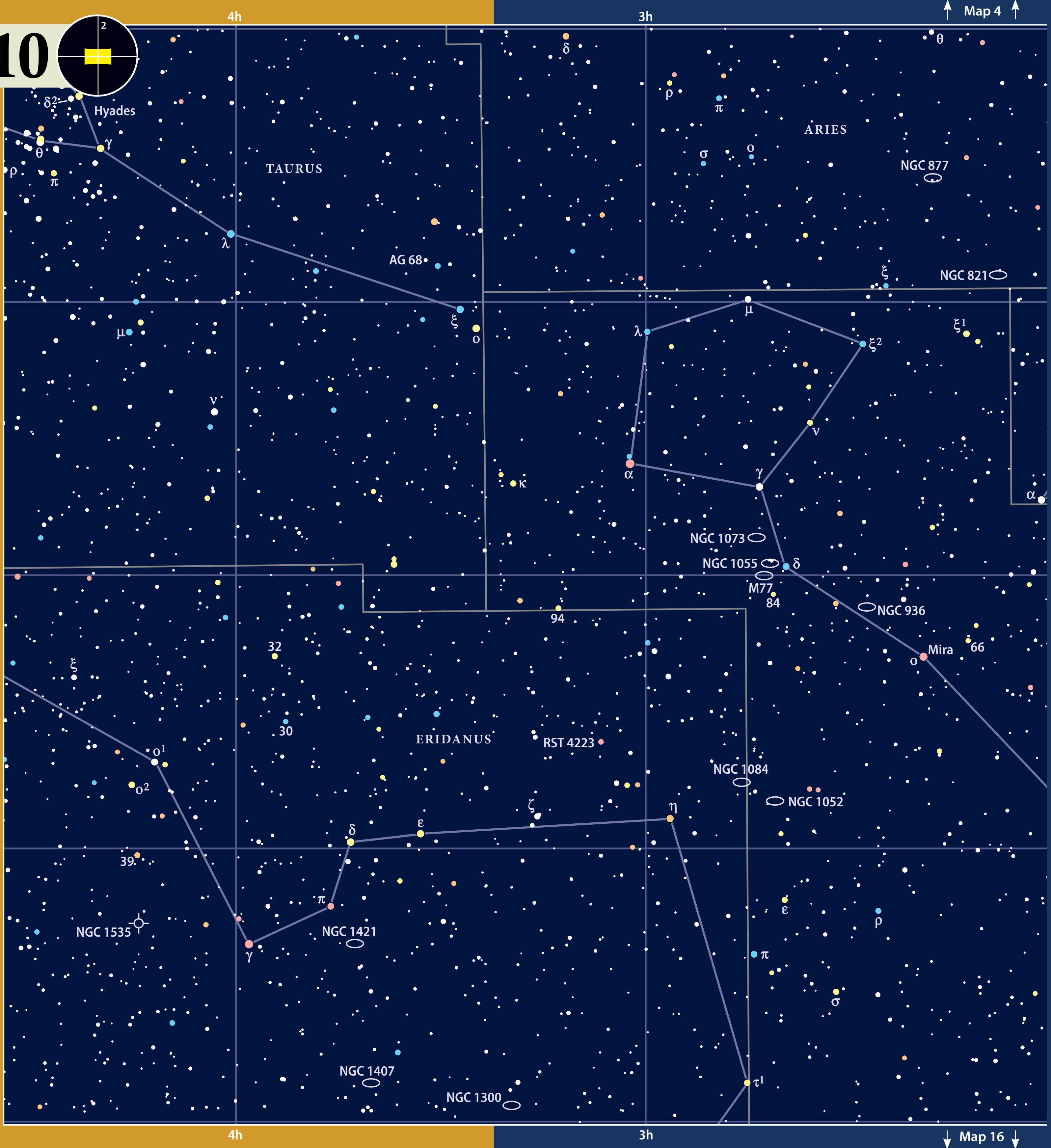

JEFF CREMER/ADAM BLOCK/NOAO/AURA/NSF

▲ **PLANETARY NEBULA NGC 246 in Cetus spans nearly 4' and shows irregular texture in its outer ring. Use an OIII filter for the best view.**



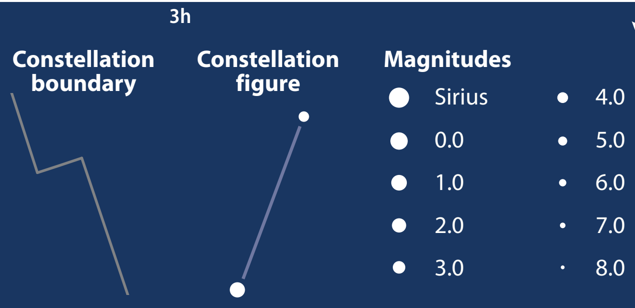
▲ **SPIRAL GALAXY NGC 772 in Aries may be interacting with NGC 770, the small elliptical galaxy above it.** ADAM BLOCK/NOAO/AURA/NSF

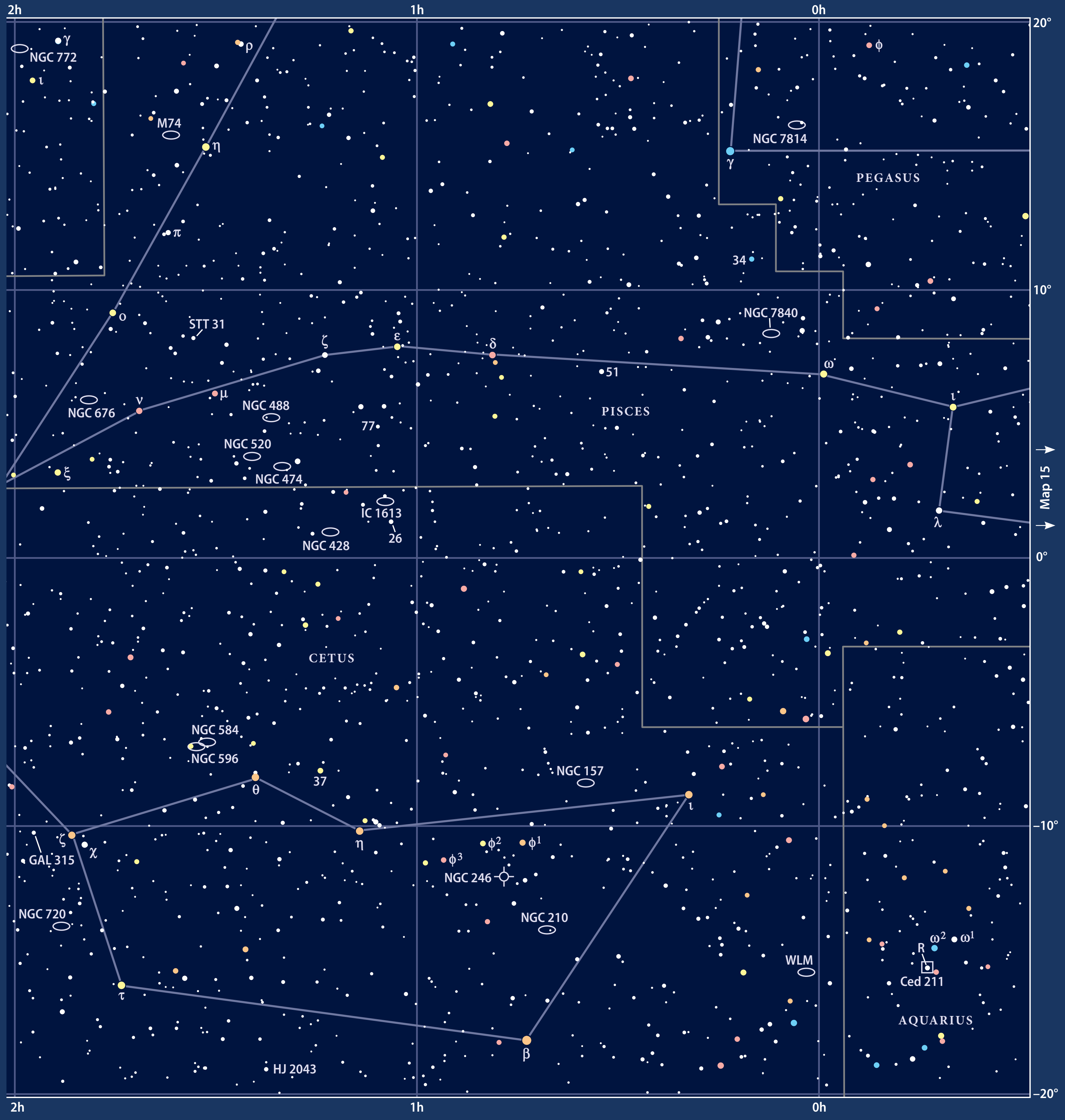
MAP 10


2
4h
3h
Map 4
Hyades
δ²
γ
θ
ρ
π
TAURUS
λ
AG 68
ξ
o
10°
μ
ν
δ
ρ
π
σ
o
ARIES
NGC 877
ξ
NGC 821
μ
λ
ξ²
ξ¹
ν
α
γ
κ
α
Map 11
NGC 1073
NGC 1055
δ
M77
84
0°
94
NGC 936
Mira
66
o
32
ξ
30
ERIDANUS
RST 4223
o¹
o²
NGC 1084
NGC 1052
ζ
η
ε
δ
–10°
39
π
ε
ρ
NGC 1535
γ
NGC 1421
π
σ
NGC 1407
NGC 1300
τ¹
–20°
Map 16

EQUATORIAL REGION 1

This map shows objects visible after sunset during mid-autumn in the Northern Hemisphere and mid-spring south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


2h
1h
0h
20°
10°
0°
−10°
−20°
NGC 772
γ
ι
ρ
M74
η
π
NGC 7814
γ
PEGASUS
ϕ
34
STT 31
o
ζ
ε
δ
NGC 7840
51
ω
ι
NGC 676
ν
μ
NGC 488
77
PISCES
NGC 520
NGC 474
ξ
IC 1613
26
NGC 428
λ
Map 15
CETUS
NGC 584
NGC 596
θ
37
NGC 157
ι
ζ
χ
GAL 315
η
ϕ2
ϕ1
ϕ3
NGC 246
NGC 720
NGC 210
WLM
ω2
ω1
R
Ced 211
τ
AQUARIUS
β
HJ 2043

◌ Open cluster
⊕ Globular cluster
□ Diffuse nebula
⌖ Planetary nebula
⬭ Galaxy

α	Alpha
β	Beta
γ	Gamma
δ	Delta
ε	Epsilon
ζ	Zeta
η	Eta
θ	Theta
ι	Iota
κ	Kappa
λ	Lambda
μ	Mu
ν	Nu
ξ	Xi
ο	Omicron
π	Pi
ρ	Rho
σ	Sigma
τ	Tau
υ	Upsilon
ϕ	Phi
χ	Chi
ψ	Psi
ω	Omega

MAP 11 EQUATORIAL REGION 2

RYAN STEINBERG AND FAMILY/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE ORION NEBULA** (M42) in Orion's sword is one of the sky's brightest nebulae. Explore it with all your eyepieces and nebula filters.

Nights of the Hunter

The heart of the winter sky fills the next star map. There, we encounter Orion the Hunter, the favorite constellation of many observers. Orion is just the start, however. Taurus, Gemini, Eridanus, Canis Minor, and Canis Major all contribute bright stars. And don't overlook Monoceros the Unicorn. Although it contains no bright stars, Monoceros is a treasure-trove of deep-sky objects and double stars.

In Taurus, open cluster **NGC 1817** glows at magnitude 7.7 and spans 16'. Simply put, look through bigger telescopes to see more stars. Through a 2.4-inch, you'll see only half a dozen stars. Between two and three dozen stars show up through a 6-inch, with most of them concentrated in a hazy cloud at the cluster's eastern edge; there's also a nice chain of stars to the west. At 100x through a 10-inch scope, you'll count 75 or more stars.

Because you're already in the area, try finding **Hind's Variable Nebula** (NGC 1554/5). When the nebula shines at its brightest, observers have spotted it through 6-inch telescopes; at other times, it's invisible through a 16-inch scope. Also known as Struve's Lost Nebula, NGC 1554–5 glows because of radiation from the variable star T Tauri.

Lots of great observing awaits you in Monoceros. Messier listed one object here — **M50** — but easily could have included three more open clusters, all of which are brighter than M50. That's not to say M50 is weak. Even through a 2.4-inch telescope, you'll see two dozen stars, and, from a dark site, you might glimpse this magnitude 5.9 cluster with your naked eyes. At 100x through a 10-inch telescope, 150 stars pop into view within an area slightly smaller than the Full Moon. Note the yellow star on the cluster's southern edge and the void near the group's center.

The three open clusters brighter than M50 lie in a 15°-long line that runs north-south. Starting at the southern end, **NGC 2232** shines at magnitude 3.9 not quite 2.5° north of Beta Monocerotis. Only about a dozen stars belong to this cluster, the brightest being 5th-magnitude 10 Monocerotis, which lies on the northern edge.

Nearly 12° north of NGC 2232 is **NGC 2244**. This magnitude 4.8 open cluster measures 20' across. Through a 6-inch telescope, you'll see 20 stars forming an oval elongated northwest to southeast. As you use larger scopes, progressively more stars will appear. It's difficult to tell, however, which belong to the cluster and which are background Milky Way stars.

/// DOUBLE-STAR DELIGHTS — MAP 11

Designation	Right ascension	Declination	Magnitudes	Separation
BU 883	4h51m	11°03'	6.8, 7.0	15.1"
Iota Leporis	5h12m	–11°51'	4.5, 10.8	12.7"
Rho Orionis	5h13m	2°52'	4.6, 8.4	6.9"
Beta Orionis	5h15m	–8°12'	0.3, 10.4	9.5"
Lambda Orionis	5h35m	9°56'	3.7, 5.6	4.4"
Iota Orionis	5h35m	–5°55'	2.9, 7.0	11.4"
Sigma Orionis	5h39m	–2°35'	4.0, 7.5	12.9"
KUI 21	5h55m	11°46'	6.5, 12.0	22.7"
Epsilon Monocerotis	6h24m	4°35'	4.5, 6.5	12.9"
Beta Monocerotis	6h29m	–7°01'	4.7, 5.2, 6.1	7.2", 9.9"
STT 143	6h31m	16°55'	6.3, 9.4	8.0"
Nu^1 Canis Majoris	6h36m	–18°40'	5.8, 8.5	17.4"
30 Geminorum	6h44m	13°14'	4.6, 11.1	27.2"
Alpha Canis Majoris	6h45m	–16°43'	–1.5, 8.5	5.5"
38 Geminorum	6h55m	13°10'	4.8, 7.1	7.1"
BU 1060	6h59m	3°35'	6.0, 11.0	3.6"
Lambda Geminorum	7h18m	16°32'	3.6, 10.7	9.6"
Eta Canis Minoris	7h28m	6°56'	5.3, 11.1	4.0"
BUP 104	7h37m	–4°06'	5.1, 13.2	26.1"
STF 1143	7h48m	5°24'	7.0, 11.0	9.3"

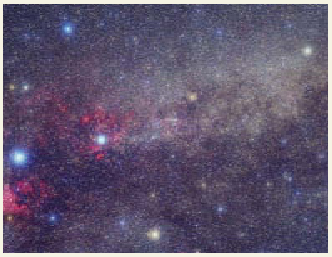
Surrounding NGC 2244, but slightly offset, is the **Rosette Nebula** (NGC 2237–9). You'll get your best views of this object through low-power eyepieces. The Rosette measures 1° across, and, although faint, you can spot it through a 3-inch telescope. For a better view, however, use a 12-inch scope, wide-field eyepiece, and a nebula filter.

Now scan 5.5° north-northeast for the **Christmas Tree Cluster** (NGC 2264). Through a small telescope at 50x, a dozen or so stars extend to the east and west of 5th-magnitude 15 Monocerotis. This line forms the 0.5°-long base of the tree, whose top points southward. The southern stars of this asterism don't belong to the cluster. Larger telescopes will show a bright strip of nebulosity 5' long radiating westward from the brightest star. This is but one enhancement of the giant emission nebula Sharpless 2–273, which extends for 2° to the west. At the top of the Christmas Tree lies the Cone Nebula, an obscuring cloud of dust visible only through the biggest amateur telescopes.

Scan 1° south-southwest of the Christmas Tree Cluster, and you'll find the fascinating reflection nebula **NGC 2261**. Also known as Hubble's Variable Nebula, this object varies in brightness and structure over periods measured in days. NGC 2261 looks like no other object through a telescope. Through a 10-inch scope, a bright wedge 2' on a side radiates to the north of the variable star R Monocerotis. The nebula's cometary form appears uniformly bright with a sharply defined edge.

In Orion, there's really only one place to start: the **Orion Nebula** (M42). Visible to the naked eye as the middle "star" in Orion's "sword," this spectacular object looks great through any size telescope and at any magnification. Through a 2.4-inch scope, you'll see the Trapezium, a

BILL AND SALLY FLETCHER



BILL AND SALLY FLETCHER

▲ **THE LITTLE DIPPER** is a well-known asterism in Ursa Minor the Little Bear. Polaris, the North Star, marks the handle's end.

◀ **THE NORTHERN CROSS** can help amateur astronomers find Cygnus the Swan.

BEYOND THE CONSTELLATION FIGURES

The sky contains 88 constellations. No overlaps or gaps exist between constellations. But other figures, called asterisms, also exist.

In the sky lore of some cultures, asterisms were coequal with constellations. And, if the truth be told, most asterisms are easier to recognize than many constellations because asterisms usually contain bright stars.

Today, we define an asterism as an unofficially recognized star pattern. This sets asterisms apart from constellations, which are star figures officially recognized by the International Astronomical Union.

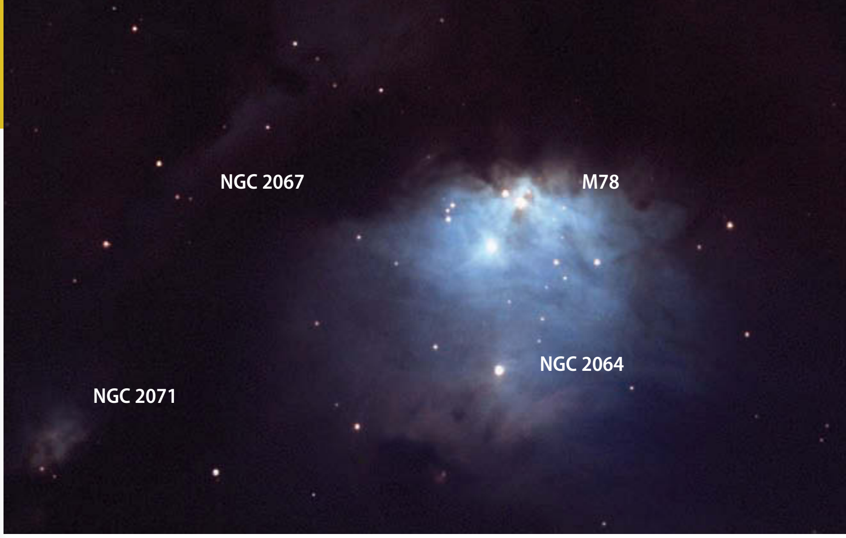
We form some asterisms from single constellations. The Big Dipper — 7 bright stars in Ursa Major — is the best example. But asterisms also may come from several constellations, as in the case of the Winter Triangle, comprising the Alpha stars of Orion, Canis Major, and Canis Minor.

group of 4 stars (Theta^1 A, B, C, and D Orionis) that formed within the nebula's gas. If you increase your telescope aperture and magnification, you'll see up to five additional stars — Theta^1 E, F, G, and H, the last of which is a double star (see the map at right). When you view this region at low power, note the Fish's Mouth, an area of dark material that protrudes into the brightest part of M42.

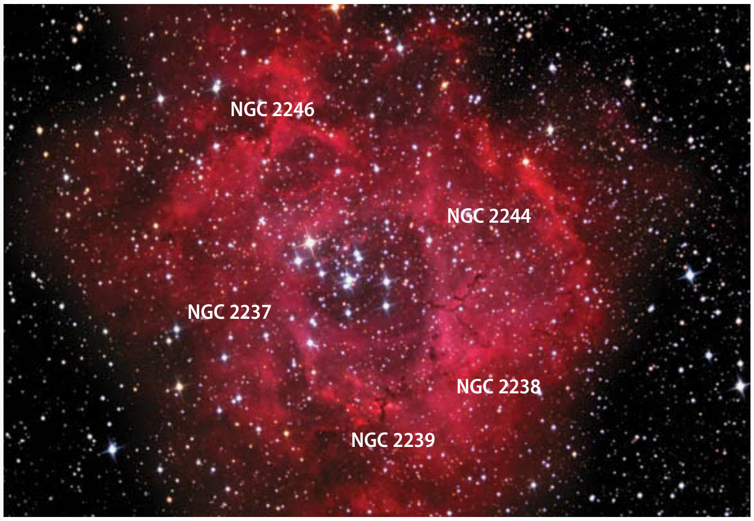
Just north of the Fish's Mouth lies **M43**, which astronomers consider a separate object only for cataloging purposes. Look for the star NU Orionis in the center of this 15'-diameter object.

Move ½° north of the Orion Nebula to find the **Running Man Nebula** (NGC 1973/5/7). The two bright stars involved with the nebula are 42 Orionis (magnitude 4.6) and 45 Orionis (magnitude 5.2). Because the Running Man Nebula is a reflection nebula, observe it without a nebula filter. Its light is reflected starlight scattered throughout the gas and dust, not reddish light emitted by hydrogen (which a nebula filter transmits).

Point your telescope at Alnitak (Zeta Orionis). Move just 18' east-northeast to the **Flame Nebula** (NGC 2024). Normally, a large object like the Flame (30' across) would be easy to see, but the glare from magnitude 1.7 Alnitak interferes. Increase the magnification enough to capture the whole Flame and to place Alnitak out of the field of view to the west.

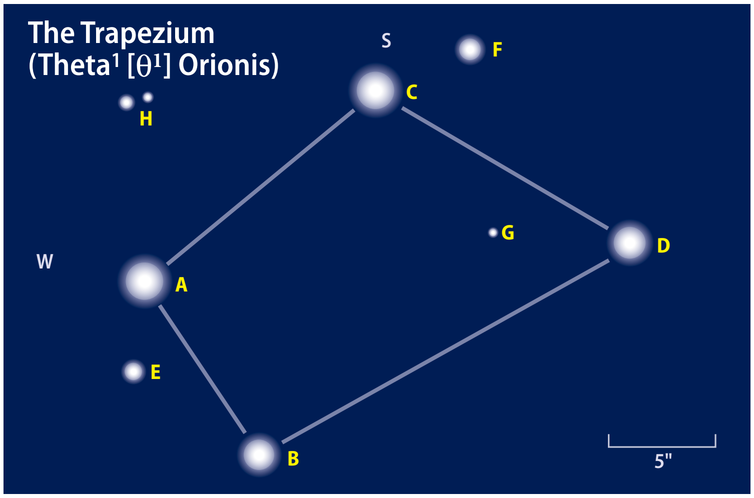


▲ **REFLECTION NEBULA** M78 in Orion is the sky's brightest reflection nebula. It lies 2½° northeast of Alnitak (Zeta Orionis). DANIEL VERSCHATSE



MICHAEL PETRASKO AND MUIR EVEDEN/ADAM BLOCK/NOAO/AURA/NSF

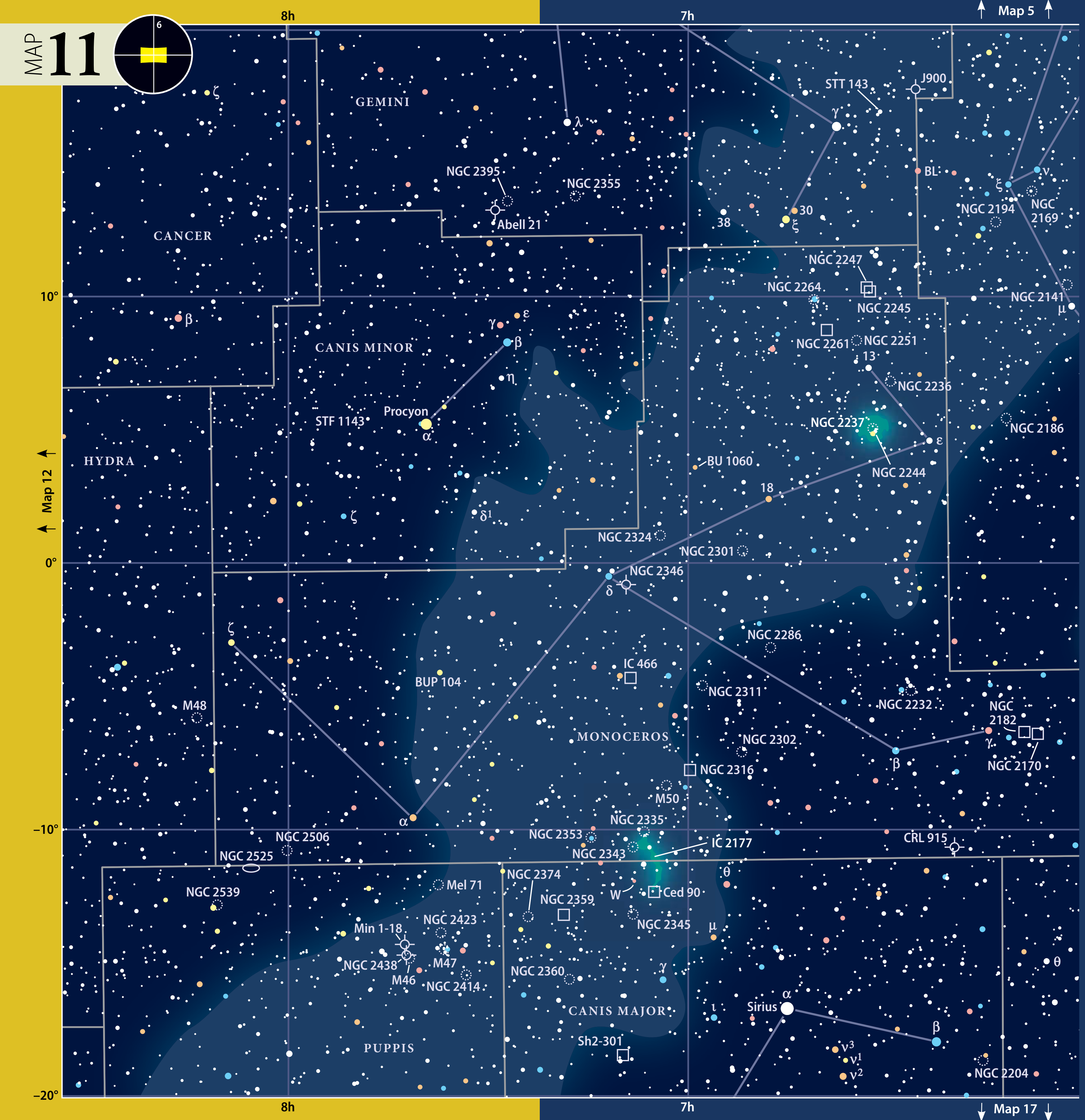
▲ **THE ROSETTE NEBULA** (NGC 2237–9) in Monoceros the Unicorn accounts for four entries in the NGC catalog, and this doesn't include the magnitude 4.8 star cluster at its center (NGC 2244).



ASTRONOMY: ROEN KELLY

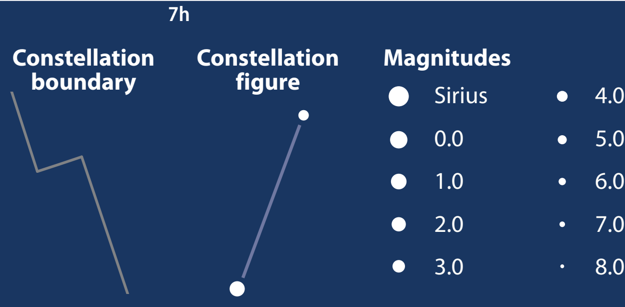
▲ **THETA^1 ORIONIS,** when seen through a small telescope, resolves into four stars called the Trapezium. Astronomers lettered the stars A, B, C, and D by right ascension, not brightness. Star A shines at magnitude 6.7, B at 8.0, C at 5.1, and D at 6.7. If your sky conditions are good, an 8-inch scope may reveal 11th-magnitude E and F. You probably will need a 14-inch telescope to find G and H, which both glow faintly at 15th magnitude.

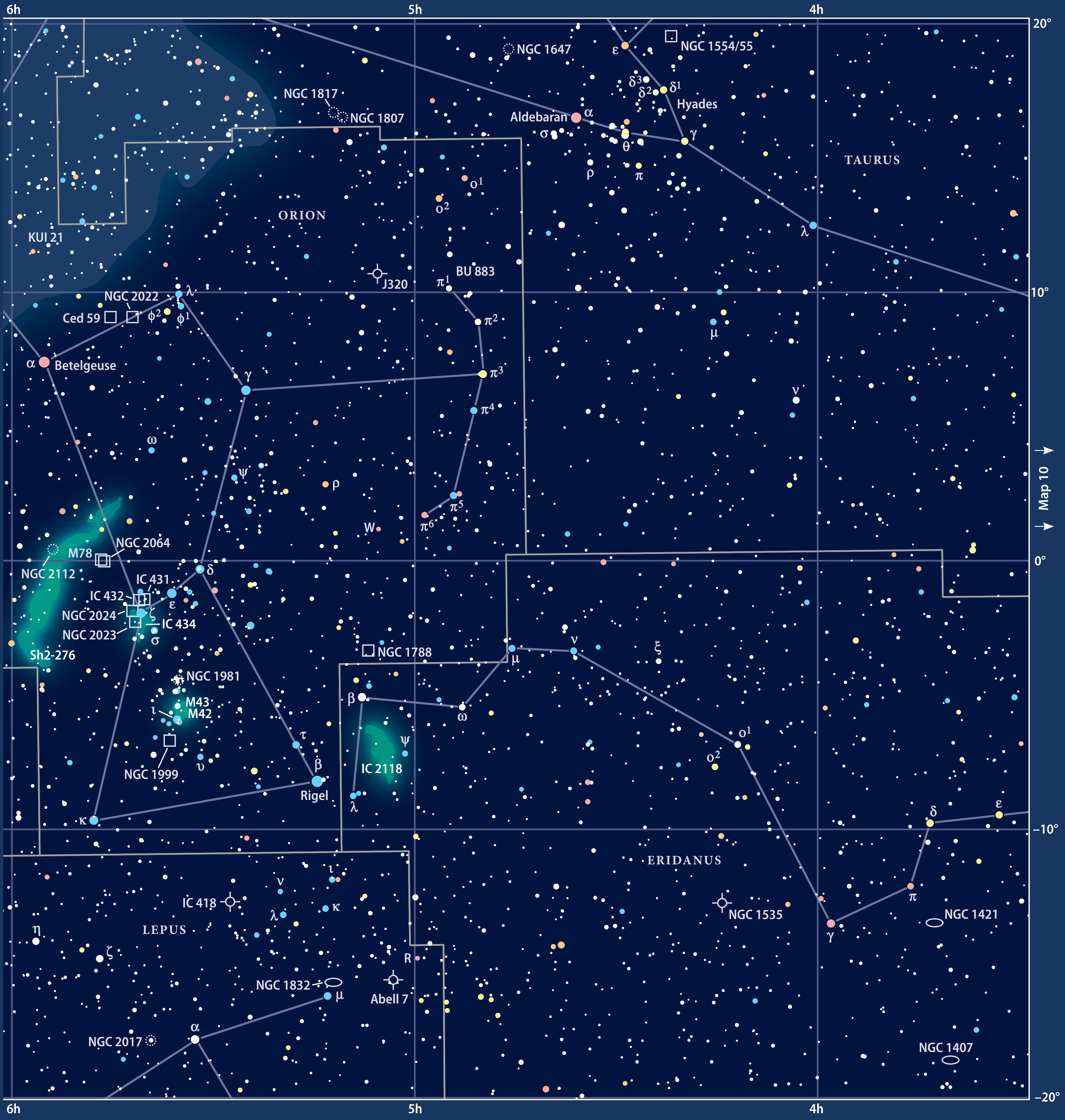
MAP 11


6
8h
7h
Map 5
GEMINI
ζ
λ
STT 143
J900
γ
NGC 2395
NGC 2355
Abell 21
30
38
ξ
BL
ξ
ν
NGC 2194
NGC 2169
CANCER
NGC 2247
NGC 2264
NGC 2245
NGC 2141
μ
10°
β
γ
ε
β
CANIS MINOR
NGC 2261
NGC 2251
13
η
NGC 2236
Procyon
STF 1143
α
NGC 2237
NGC 2186
ε
HYDRA
BU 1060
NGC 2244
Map 12
18
ζ
δ1
NGC 2324
NGC 2301
0°
NGC 2346
δ
ζ
NGC 2286
IC 466
BUP 104
M48
NGC 2311
NGC 2232
NGC 2182
MONOCEROS
NGC 2302
γ
β
NGC 2170
NGC 2316
M50
α
NGC 2335
−10°
NGC 2506
NGC 2353
IC 2177
CRL 915
NGC 2525
NGC 2343
θ
NGC 2539
NGC 2374
Mel 71
W
Ced 90
NGC 2359
NGC 2423
NGC 2345
μ
Min 1-18
θ
NGC 2438
M47
M46
γ
NGC 2414
NGC 2360
Sirius
α
CANIS MAJOR
ι
PUPPIS
β
ν3
ν1
Sh2-301
ν2
NGC 2204
−20°
8h
7h
Map 17

EQUATORIAL REGION 2

This map displays constellations and deep-sky objects during mid-winter north of the equator and mid-summer in the Southern Hemisphere.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


6h
5h
4h
20°
10°
0°
–10°
–20°
Map 10
NGC 1647
NGC 1554/55
ε
δ^3
δ^2
δ^1
Hyades
NGC 1817
NGC 1807
Aldebaran
α
σ
θ
γ
ρ
π
TAURUS
o^1
o^2
ORION
KUI 21
λ
J320
BU 883
π^1
π^2
π^3
π^4
π^5
π^6
NGC 2022
Ced 59
ϕ^2
ϕ^1
α
Betelgeuse
γ
μ
ν
ω
ψ
ρ
W
M78
NGC 2064
NGC 2112
δ
IC 431
IC 432
ε
ζ
NGC 2024
IC 434
NGC 2023
σ
Sh2-276
NGC 1788
μ
ν
ξ
NGC 1981
M43
M42
ι
β
ω
τ
ψ
IC 2118
NGC 1999
υ
β
Rigel
λ
κ
o^1
o^2
δ
ε
ERIDANUS
π
γ
NGC 1535
NGC 1421
ι
ν
IC 418
κ
λ
LEPUS
η
ζ
R
NGC 1832
μ
Abell 7
NGC 2017
α
NGC 1407

◌ Open cluster
⊕ Globular cluster
□ Diffuse nebula
⌖ Planetary nebula
⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	ϕ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

TOM BASH AND JOHN FOX/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE BEEHIVE CLUSTER (M44) in Cancer makes a fine binocular target. From a dark site, you'll see it easily with naked eyes.**

DOUBLE-STAR DELIGHTS — MAP 12

Designation	Right ascension	Declination	Magnitudes	Separation
HO 350	8h04m	12°11'	6.7, 10.8	4.8"
Epsilon Hydrae	8h47m	6°25'	3.5, 6.8	3.2"
Rho Hydrae	8h48m	5°49'	4.4, 11.9	12.4"
Struve 1295	8h55m	–7°57'	6.7, 6.9	4.2"
Alpha Cancri	8h59m	11°51'	4.3, 11.8	10.9"
Theta Hydrae	9h14m	2°19'	3.8, 9.8	27.1"
Gamma Leonis	10h20m	19°50'	2.6, 3.8	4.5"
Chi Leonis	11h05m	7°20'	4.7, 11.0	3.6"
Gamma Crateris	11h25m	–17°41'	4.1, 9.6	5.3"
83 Leonis	11h27m	3°02'	6.5, 7.6	40.8"
90 Leonis	11h35m	16°47'	6.1, 7.4	3.4"

The Lion's galaxies

Leo the Lion dominates the next map. No fewer than five Messier objects — all bright galaxies — await you there.

Before you begin hunting galaxies, however, pull out your binoculars, and look toward Cancer the Crab at the open cluster called the **Beehive** (M44). Binoculars labeled 7x50 will show you the Beehive's overall structure, but 15x or higher binoculars reveal star patterns that resemble arcs or chains. For best results, mount your binoculars on a sturdy camera tripod. If you choose to observe M44 through a telescope, use low power.

Next, focus on **M67** in Cancer. Through binoculars, you might mistake M67 for a magnitude 6.9 globular cluster. It is, in fact, an open cluster that large telescopes show to be 30' across — the same size as the Full Moon. Through an 8-inch scope, you'll see 50 stars, and nearly double that through a 12-inch instrument.

In Leo, light from brilliant Regulus (Alpha Leonis) hides one of the Milky Way's dwarf companion galaxies, **Leo I** (it doesn't have an NGC number). This object shines at magnitude 10.2 — bright for a galaxy, but more than 4,300 times fainter than Regulus. Leo I lies 20' due north of Regulus, so place the bright star out of your field of view to the south, and look for a moderate brightening of the background roughly 8' across.

While you're in Leo, scan 1.5° south of Lambda Leonis to find **NGC 2903** (Map 6). Observers often overlook this spiral galaxy in favor of Leo's five Messier objects. NGC 2903, however, is brighter than all but M65. A 10-inch scope shows a halo measuring 4' by 2' around a bright core.

Midway between Gamma and Zeta Leonis lies Hickson 44, a group of four galaxies centered on **NGC 3190** (Map 6). Hickson 44 is one of 100 compact galaxy groups in a catalog compiled in the 1980s by Canadian astronomer Paul Hickson. Magnitude 11.2 NGC 3190 is the brightest member of the group, which also includes NGC 3185, NGC 3187, and NGC 3193. You'll need at least a 10-inch telescope to see all four.

Less than 1° east of magnitude 2.0 Gamma Leonis lies magnitude 10.3 **NGC 3227**. The galaxy is a fine target on its own, but what makes it special is its interaction with NGC 3226, a magnitude 12.3 elliptical galaxy seemingly attached to NGC 3227's northern end. NGC 3227 appears nearly round, measuring 4.1' by 3.9'.

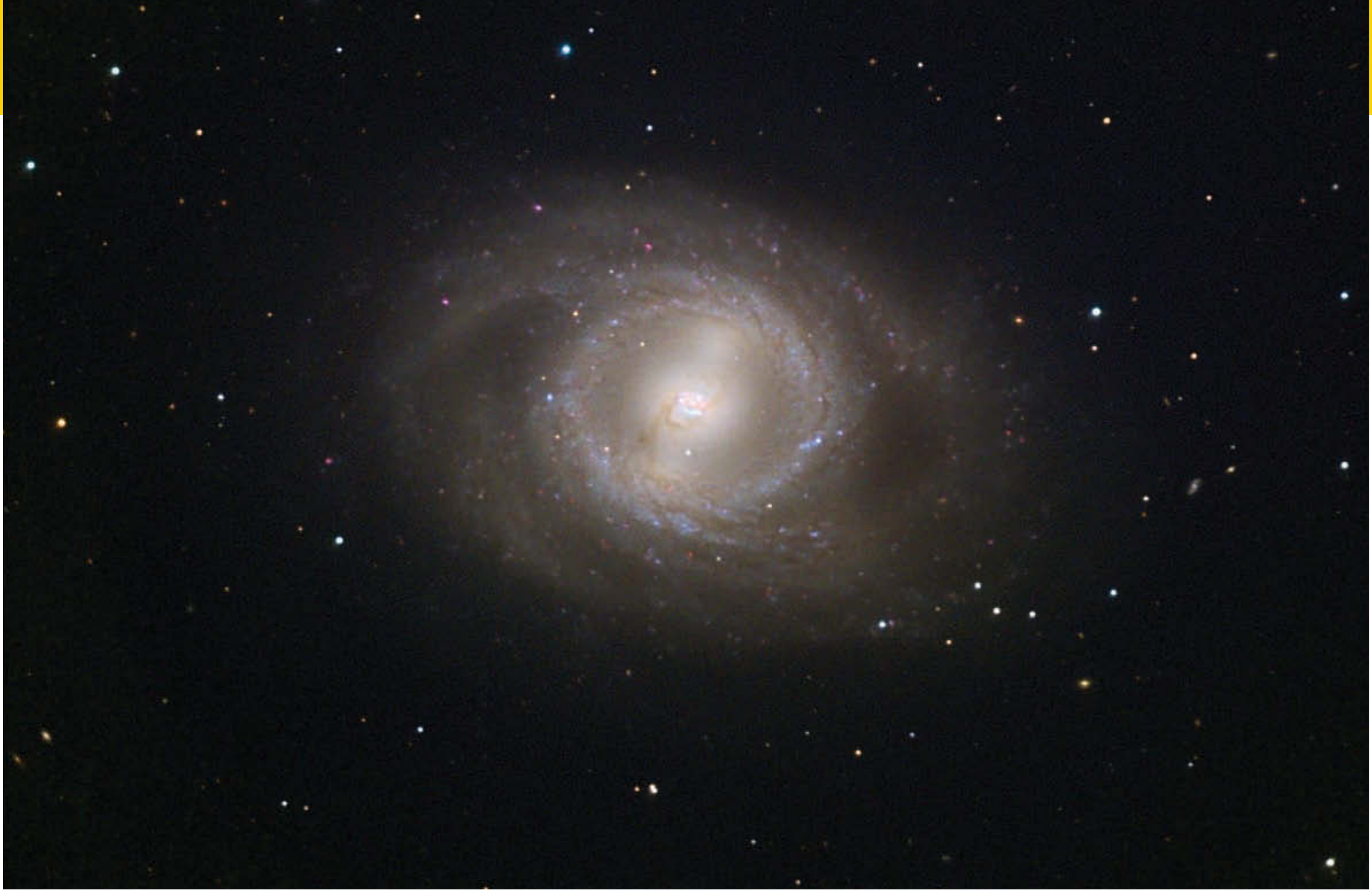
DOC. G. AND DICK GODDARD/ADAM BLOCK/NOAO/AURA/NSF

▲ **SPIRAL GALAXY M65 in Leo shines at magnitude 8.8 and measures 10' by 2.7'. It lies 35 million light-years away.**

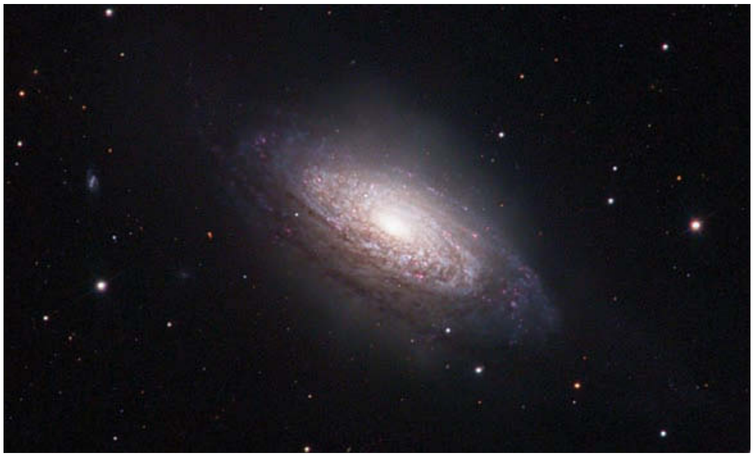
Draw a line between Rho and Theta Leonis, then travel 4° along this line to three bright Messier objects. These galaxies — **M95**, **M96**, and **M105** — and six others belong to the M96 Group. You can view M95, M96, and M105 together if you use an eyepiece that gives at least a 1.5° field of view. M95 is a spiral galaxy that shines at magnitude 9.7. M96 is also a spiral, but it's a half-magnitude brighter at 9.2. Just a tad fainter, elliptical galaxy M105 glows at magnitude 9.3.

Three more bright galaxies — the Leo Triplet — lie 2.5° southeast of Theta Leonis, midway between it and Iota Leonis. An eyepiece with a 1° field of view encompasses all three, but you'll want to crank up the power on each to examine its details.

First is spiral galaxy **M65**, which marks the Triplet's southwestern corner. M65 shines at magnitude 8.8 and measures 4 times as long as it is wide. Through a 10-inch or larger telescope, look for irregular structure


MIKE O'CONNOR, TRISTAN DILAPO, AND GARY KIELICH/ADAM BLOCK/NOAO/AURA/NSF

▲ **BARRED SPIRAL GALAXY M95 in Leo is a member of the Leo I group, which also contains M96 and M105. This group lies approximately 38 million light-years away. M95 measures 4.4' by 3.3'.**

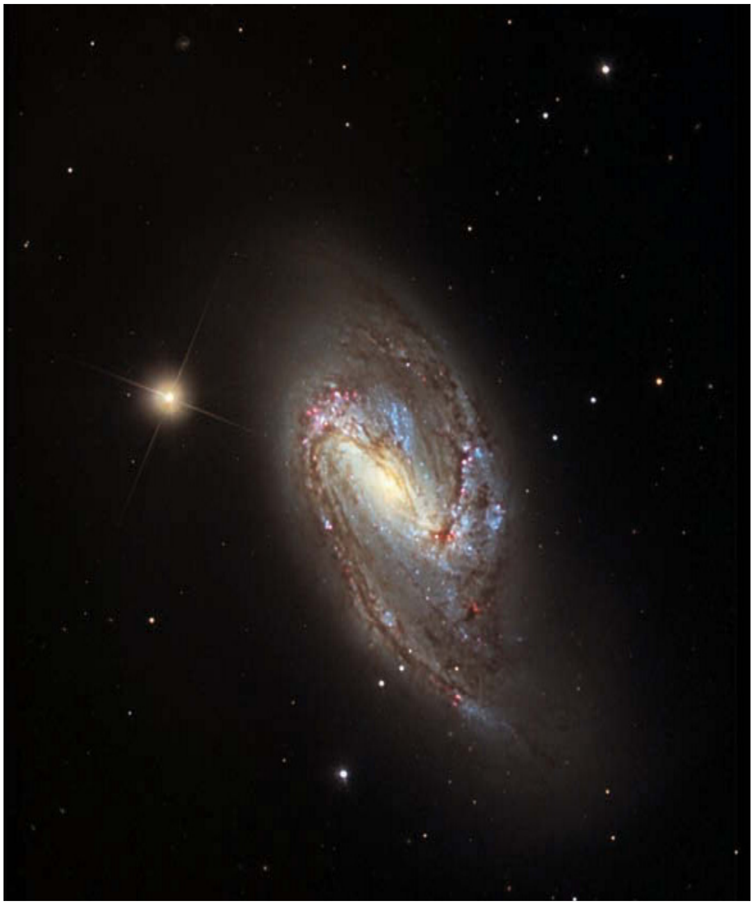

DANIEL VERSCHATSE

▲ **SPIRAL GALAXY NGC 3521 in Leo can be spotted through binoculars, but, to see the most detail, use a telescope at medium or high power.**

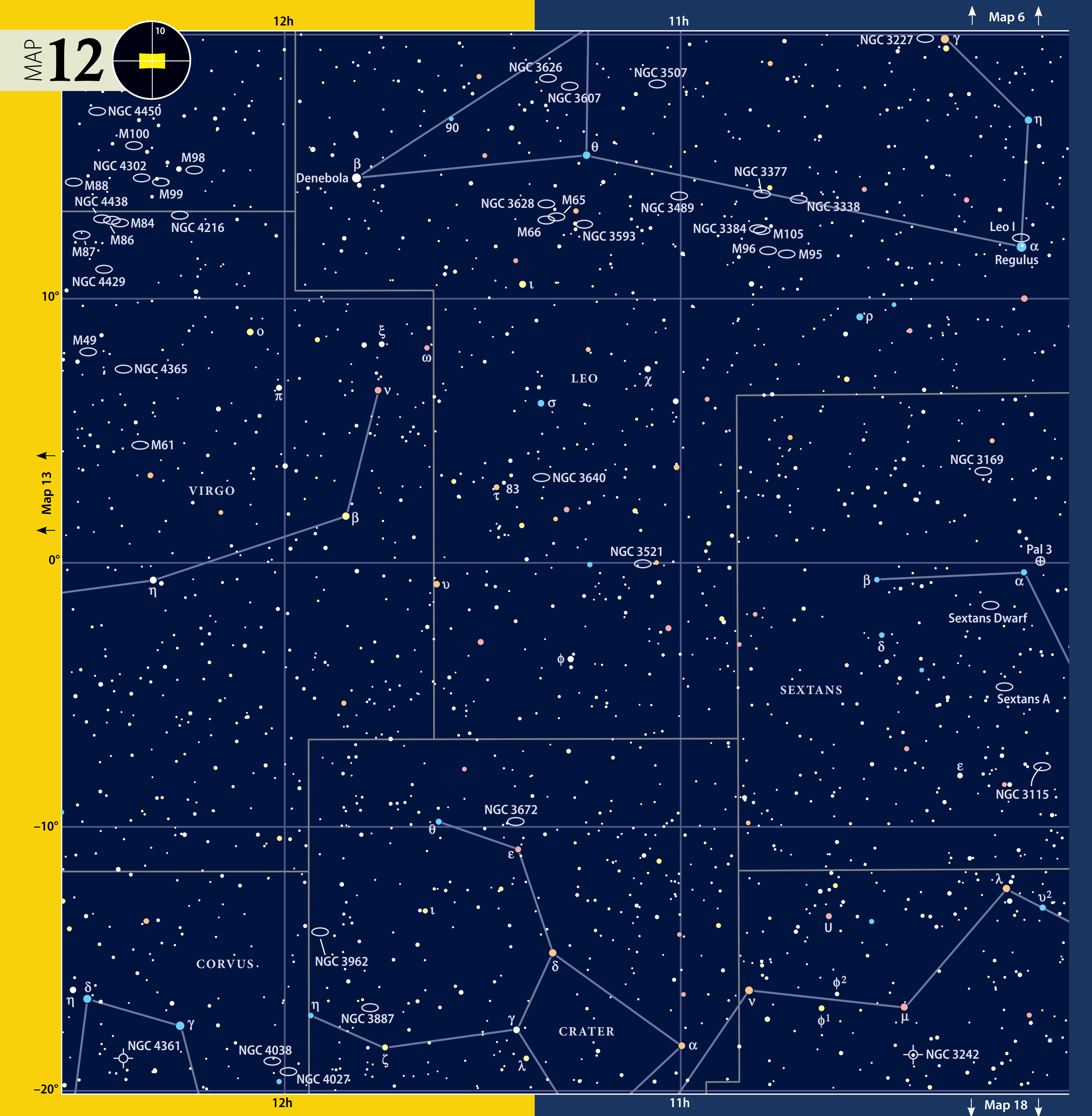
near M65's core. This galaxy appears somewhat inclined to the line of sight. Measurements show M65 tilts 15° from being classified as edge-on.

At magnitude 9.0, spiral galaxy **M66** ranks as one of the 20 brightest galaxies in the sky. M66 measures 8' by 4', and its arms wrap tightly around its core. Use at least a 12-inch telescope to pick out its arms.

NGC 3628 completes the triplet and appears much fainter than M65 or M66. At magnitude 9.5, it's really not that much dimmer than its neighbors, but its light spreads over an area measuring 14' by 4'. Look for a faint dust lane south of NGC 3628's center.

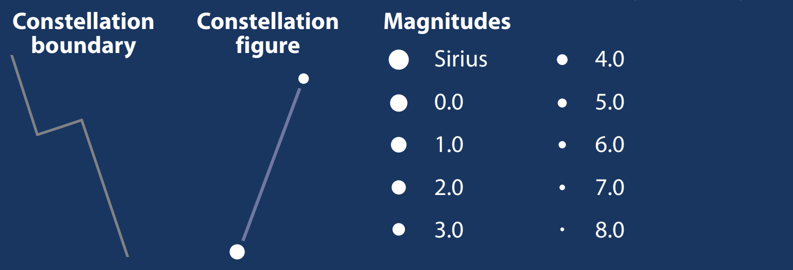

JEFF HAPEMAN/ADAM BLOCK/NOAO/AURA/NSF

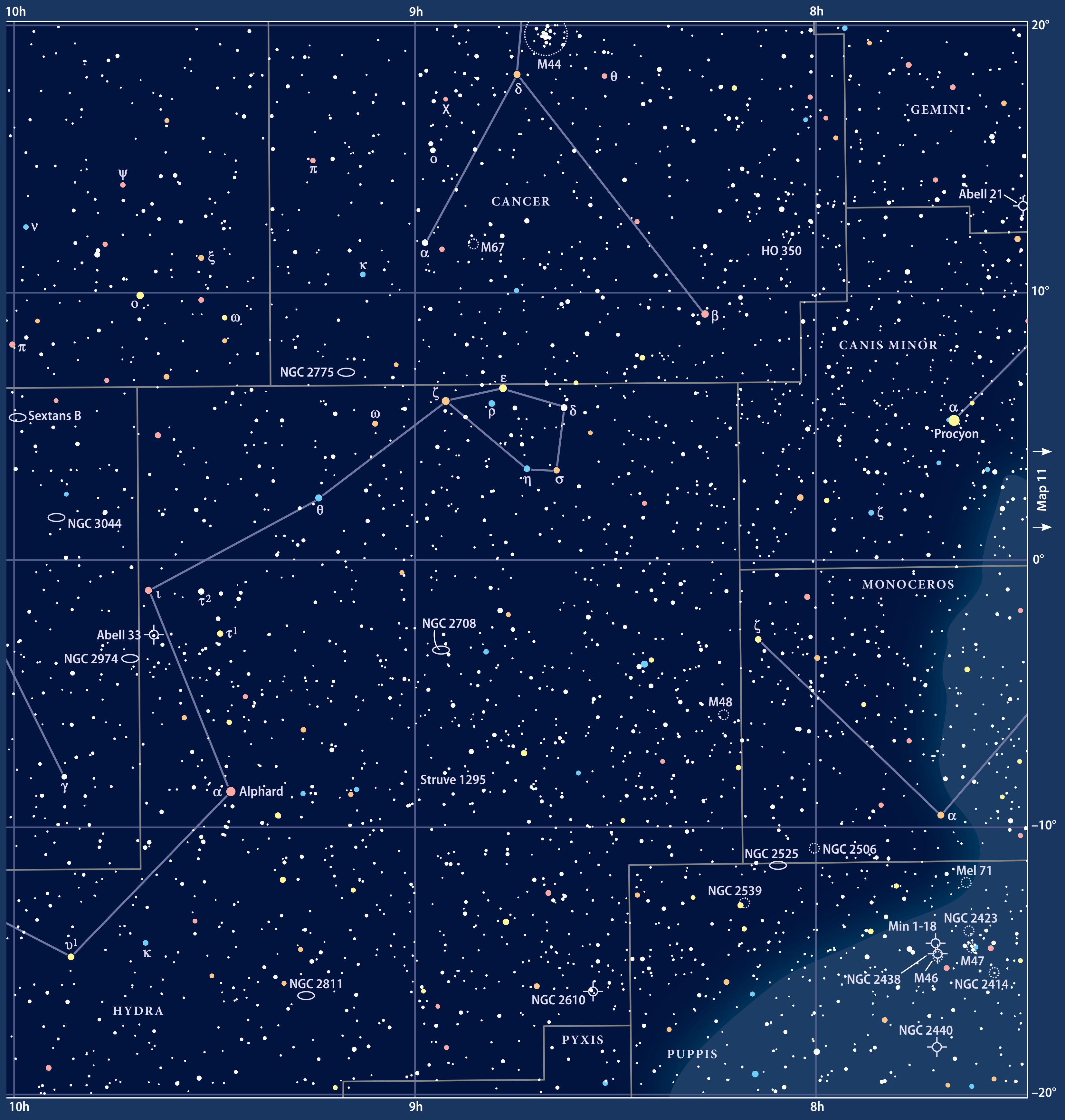
▲ **M66 IN LEO is a magnitude 9.0 spiral galaxy, which measures 9' by 4'. Along with M65 and NGC 3628, it forms the Leo Triplet.**


MAP 12
10
12h
11h
Map 6
NGC 3227
γ
NGC 3626
NGC 3507
NGC 3607
NGC 4450
M100
90
η
θ
M98
NGC 4302
β
Denebola
NGC 3377
M88
M99
NGC 4438
NGC 3628
M65
NGC 3489
NGC 3338
M84
NGC 4216
Leo I
M66
NGC 3593
NGC 3384
M105
M86
α
M87
M96
M95
Regulus
NGC 4429
ι
10°
ρ
M49
ο
ξ
ω
NGC 4365
LEO
χ
π
ν
σ
M61
NGC 3169
Map 13
NGC 3640
τ
83
VIRGO
β
NGC 3521
Pal 3
0°
β
α
η
υ
Sextans Dwarf
δ
φ
SEXTANS
Sextans A
ε
NGC 3115
NGC 3672
θ
−10°
ε
λ
υ²
ι
U
NGC 3962
CORVUS
δ
φ²
ν
δ
φ¹
μ
η
η
NGC 3887
γ
γ
CRATER
NGC 4361
ζ
α
NGC 4038
NGC 3242
λ
NGC 4027
−20°
12h
11h
Map 18

EQUATORIAL REGION 3

This map's stars and constellations decorate the evening sky in early spring in the Northern Hemisphere and early autumn south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


10h
9h
8h
20°
M44
δ
θ
χ
GEMINI
ο
ψ
π
CANCER
Abell 21
ν
ξ
κ
α
M67
HO 350
10°
ο
ω
β
π
CANIS MINOR
NGC 2775
ε
ζ
Sextans B
ω
ρ
δ
α
Procyon
η
σ
Map 11
θ
ζ
NGC 3044
0°
ι
τ2
MONOCEROS
Abell 33
τ1
NGC 2708
ζ
NGC 2974
M48
γ
α
Alphard
Struve 1295
α
−10°
NGC 2525
NGC 2506
Mel 71
NGC 2539
Min 1-18
NGC 2423
υ1
κ
M47
NGC 2438
M46
NGC 2414
NGC 2811
NGC 2610
HYDRA
NGC 2440
PYXIS
PUPPIS
−20°
10h
9h
8h

◌ Open cluster

⊕ Globular cluster

☐ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega

MAP 13 EQUATORIAL REGION 4

SALLY AND CURT KING/ADAM BLOCK/NOAO/AURA/NSF

GLOBULAR CLUSTER M5 in Serpens appears as a fuzzy magnitude 5.7 star to the unaided eye. Through a telescope, it explodes with detail.

Realm of the nebulae

Nineteenth-century observers called the area covered by Map 13 the “realm of the nebulae.” They weren’t describing nebulae in the current sense, however. Their nebulae were galaxies, which looked nebulous through the small telescopes most observers used. Luckily, amateur scopes today are bigger, better, and easier to acquire. Unfortunately, our sky is brighter due to light pollution.

Roughly 9° east-southeast of Epsilon Virginis, you’ll find **NGC 5248**. This magnitude 10.3 spiral galaxy actually resides in the southwest corner of Boötes and is that constellation’s brightest galaxy. NGC 5248’s bright core and outer regions show up even through small telescopes. A 12-inch scope shows a barely elongated oval 3.5' by 3' with a stellar nucleus slightly offset to the north. You’ll also see a prominent dark patch south of the core and some of the structure making up the spiral arms. If you’re observing with an even larger scope, look for two of NGC 5248’s 15th-magnitude companion galaxies: UGC 8575 lies 27' to the west, and UGC 8629 is 30' to the southeast.

Of the 88 constellations, Serpens the Serpent is the only one that’s not contiguous. Stellar cartographers call its western part, or head, Serpens Caput and its eastern part, or tail, Serpens Cauda. Map 13 contains most of Serpens Caput. Find Serpens Cauda on Map 14.

The brightest deep-sky object in Serpens Caput is globular cluster **M5**. You’ll see M5 without optical aid from a dark site — it shines at magnitude 5.7. The almost equally bright star 5 Serpentis lies 22' to the southeast; M5 looks fuzzier. Through a telescope, however, M5 really stands out. Through a 6-inch scope, the cluster appears 10' in diameter with a densely packed center about one-quarter its diameter. Through a 10-inch telescope, individual stars appear to form streamers that cross the cluster and radiate from it.

The northern part of Libra is bereft of deep-sky objects within the reach of small scopes. If your telescope measures 12 inches or larger, however, many galaxies lie beyond the magnitude 11 threshold. Among them are **NGC 5728**, **NGC 5812**, and **NGC 5878**.

/// MESSIER OBJECTS IN COMA BERENICES AND VIRGO

Object	Type	Magnitude
M49	Elliptical galaxy	8.4
M53	Globular cluster	7.7
M58	Spiral galaxy	9.6
M59	Elliptical galaxy	9.6
M60	Elliptical galaxy	8.8
M61	Spiral galaxy	9.6
M64	Spiral galaxy	8.5
M84	Elliptical galaxy	9.1
M85	Spiral galaxy	9.1
M86	Elliptical galaxy	8.9
M87	Elliptical galaxy	8.6
M88	Spiral galaxy	9.6
M89	Elliptical galaxy	9.7
M90	Spiral galaxy	9.5
M91	Spiral galaxy	10.1
M98	Spiral galaxy	10.1
M99	Spiral galaxy	9.9
M100	Spiral galaxy	9.3
M104	Spiral galaxy	8.0

PAUL AND DANIEL KOBLAS/ADAM BLOCK/NOAO/AURA/NSF

M90 IN VIRGO spans 9.5' by 4.5' and offers impressive detail through an 8-inch telescope. Through a larger scope, fainter background galaxies appear.

Approximately 2° southeast of Eta Crateris, you’ll find the **Antennae** (NGC 4038 and NGC 4039). The bright tails of these interacting galaxies are huge plumes of material thrown out by tidal interactions. This pair is visible, although indistinct, through a 6-inch telescope. Move up to a 12-inch scope, and you’ll notice NGC 4038 is the brighter of the two. Both cores will be visible at 100x through a 12-inch scope. If you increase the magnification to 200x, you’ll see bright knots, mainly in NGC 4038. If you want to see the tails, attend a spring star party and hope someone there has a 24-inch telescope.

Below and nearly equidistant from Delta and Gamma Corvi lies planetary nebula **NGC 4361**. This magnitude 10.9 object shows up well even through a 6-inch scope because its light concentrates in an area only about 1' across. Increase the magnification, and you’ll see NGC 4361’s irregular edge and relatively bright central star.

Moving to Coma Berenices, it’s hard to believe it holds so many deep-sky treasures. Map 13 contains only the southern half of the constellation, but even that small area holds seven Messier objects.

Two globular clusters populate Coma’s southeastern corner. **M53** lies 1° northeast of Alpha Comae Berenices, and you’ll find **NGC 5053** 1.5° east of the star. M53 shines at magnitude 7.7 and measures about 12' across. A 6-inch telescope will resolve its outer stars well and show the core as broad and dense. In contrast, magnitude 9.9 NGC 5053 is one of the least concentrated globulars, looking somewhat like a tight open cluster. Even a 12-inch scope shows only about 30 stars in a 5'-wide area.

Just 2° east-southeast of 11 Comae lies spiral galaxy **NGC 4450**. Through a 10-inch scope, this magnitude 10.1 object covers roughly 4' by 3'. You’ll see a 9th-magnitude star 4' to the southwest. NGC 4450’s core appears lumpy with a starlike nucleus slightly off-center to the east.

/// DOUBLE-STAR DELIGHTS — MAP 13

Designation	Right ascension	Declination	Magnitudes	Separation
Beta Virginis	11h51m	1°45'	3.8, 8.8	12.3"
Delta Corvi	12h30m	–16°31'	3.1, 9.3	24.1"
Gamma Virginis	12h42m	–1°26'	3.6, 3.7	3.7"
Theta Virginis	13h10m	–5°32'	4.4, 9.4	7.1"
54 Virginis	13h13m	–18°49'	6.8, 7.3	5.3"
STF 1750	13h30m	–6°26'	6.1, 11.4	29.8"
Phi Virginis	14h28m	–2°13'	5.0, 9.5	5.1"
BU 1085	14h59m	–4°59'	6.1, 13.2	9.4"
18 Librae	14h59m	–11°08'	6.0, 10.2	19.8"
5 Serpentis	15h19m	1°47'	5.2, 10.2	11.3"
6 Serpentis	15h21m	0°43'	5.5, 10.1	3.1"
Delta Serpentis	15h35m	10°32'	4.2, 5.2	4.0"

▲ **SPIRAL GALAXY** M61 in Virgo is similar in size to our Milky Way. This magnitude 9.6 giant spans 100,000 light-years. ADAM BLOCK/NOAO/AURA/NSF

ADAM BLOCK/NOAO/AURA/NSF

▲ **THE EYES** (NGC 4438 [left] and NGC 4435) lie in the Virgo cluster. These interacting galaxies glow at magnitudes 10.2 and 10.8, respectively.

DANIEL VERSCHATSE

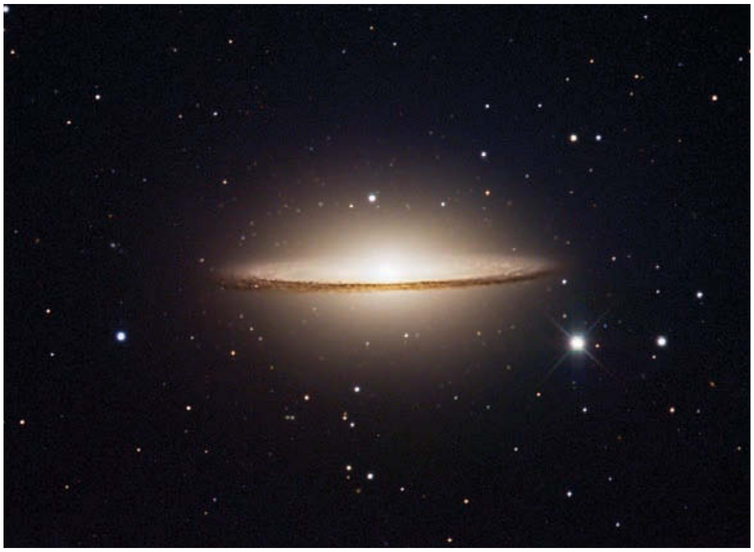
▲ **SPIRAL GALAXY** M100 in Coma Berenices lies in a rich star field. Through a 12-inch telescope, you'll see hundreds of galaxies nearby.

Finally, we come to Virgo. If you're a galaxy-hunter, you can spend a whole season in this one constellation. Virgo holds more bright galaxies than any other constellation.

Start about 4.5° south-southeast of Gamma Virginis at elliptical galaxy **NGC 4697**. At magnitude 9.3, this is a bright object, but detail is lacking because of its distance. Through a 10-inch telescope, NGC 4697 appears 2' by 1' with a large, bright core and a faint halo.

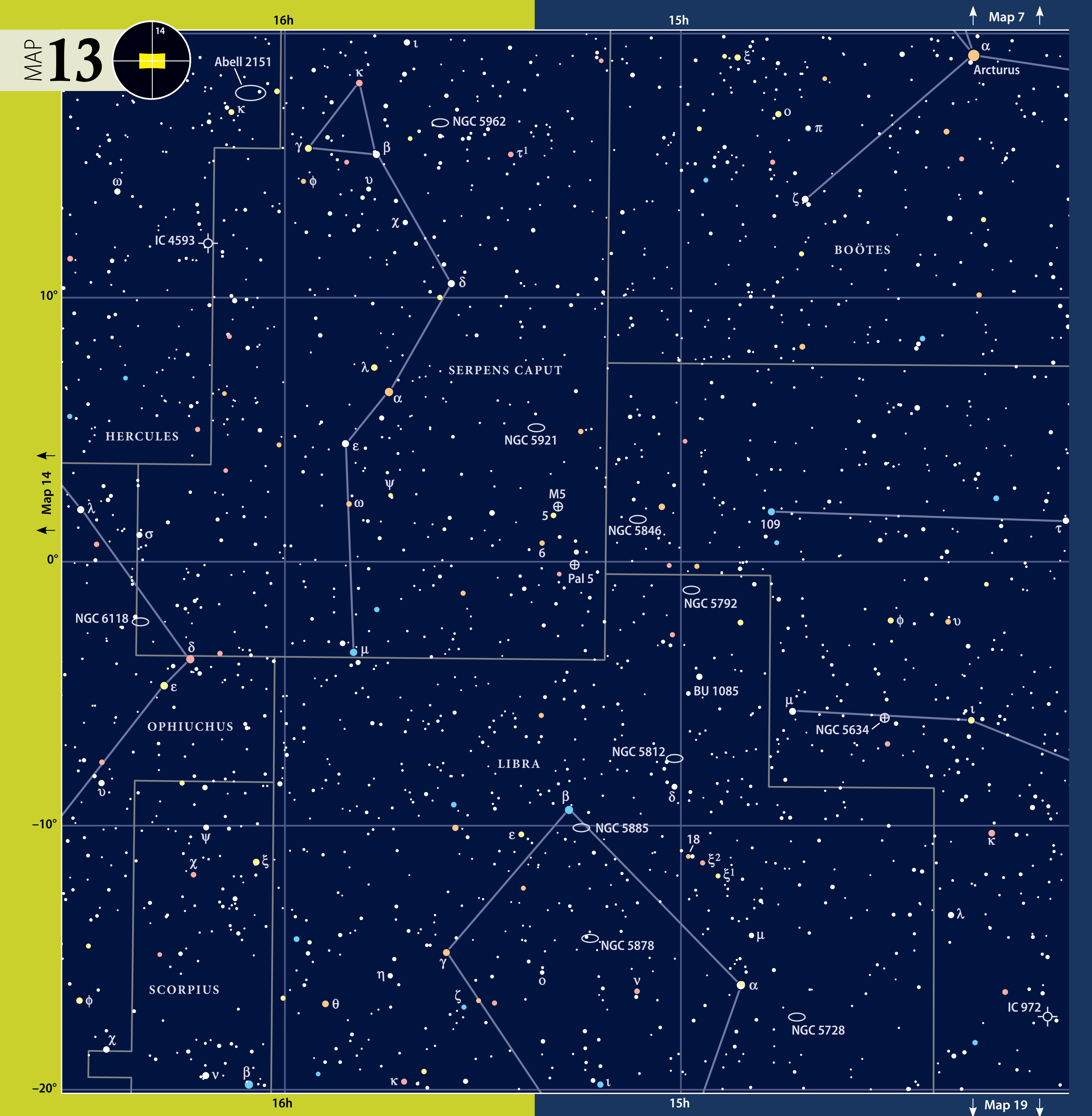
Move 3° south from NGC 4697 to find **NGC 4699**. At first glance through a 6-inch scope, this object looks like an elliptical galaxy similar to NGC 4697. In fact, it's a tightly wound spiral galaxy. Use a 12-inch or larger telescope and high power to see its arms. NGC 4699 measures 3.5' by 2.5' and glows brightly (for a galaxy) at magnitude 9.6.

Only one non-galaxy, non-stellar deep-sky object brighter than magnitude 12 resides in Virgo, and it's a worthwhile target — globular cluster **NGC 5634**. To find it, point your scope midway between Mu and Iota Virginis. In addition to the cluster, a magnitude 8.5 foreground star lurks only 1.3' east-southeast of NGC 5634's center. NGC 5634 shines at magnitude 9.4 and measures about 5' across.



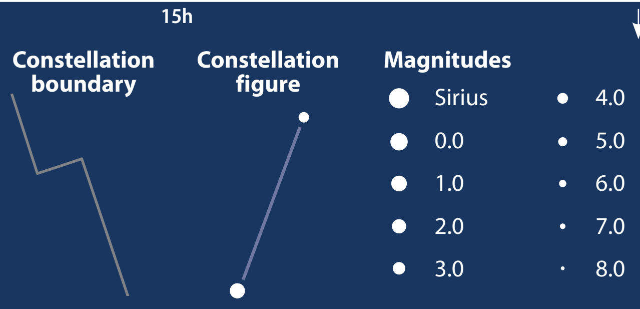
DANIEL VERSCHATSE

▲ **THE SOMBRERO GALAXY** (M104) is a favorite target among observers. Look for the dust and cold gas that splits this object lengthwise.


MAP 13
14
Map 7
Map 14
Map 19
16h
15h
10°
0°
–10°
–20°
Abell 2151
NGC 5962
IC 4593
SERPENS CAPUT
HERCULES
BOÖTES
Arcturus
NGC 5921
M5
NGC 5846
109
Pal 5
NGC 5792
NGC 6118
BU 1085
NGC 5634
OPHIUCHUS
LIBRA
NGC 5812
NGC 5885
18
NGC 5878
SCORPIUS
NGC 5728
IC 972

EQUATORIAL REGION 4

View the constellations and deep-sky objects on this map during early summer in the Northern Hemisphere and early winter south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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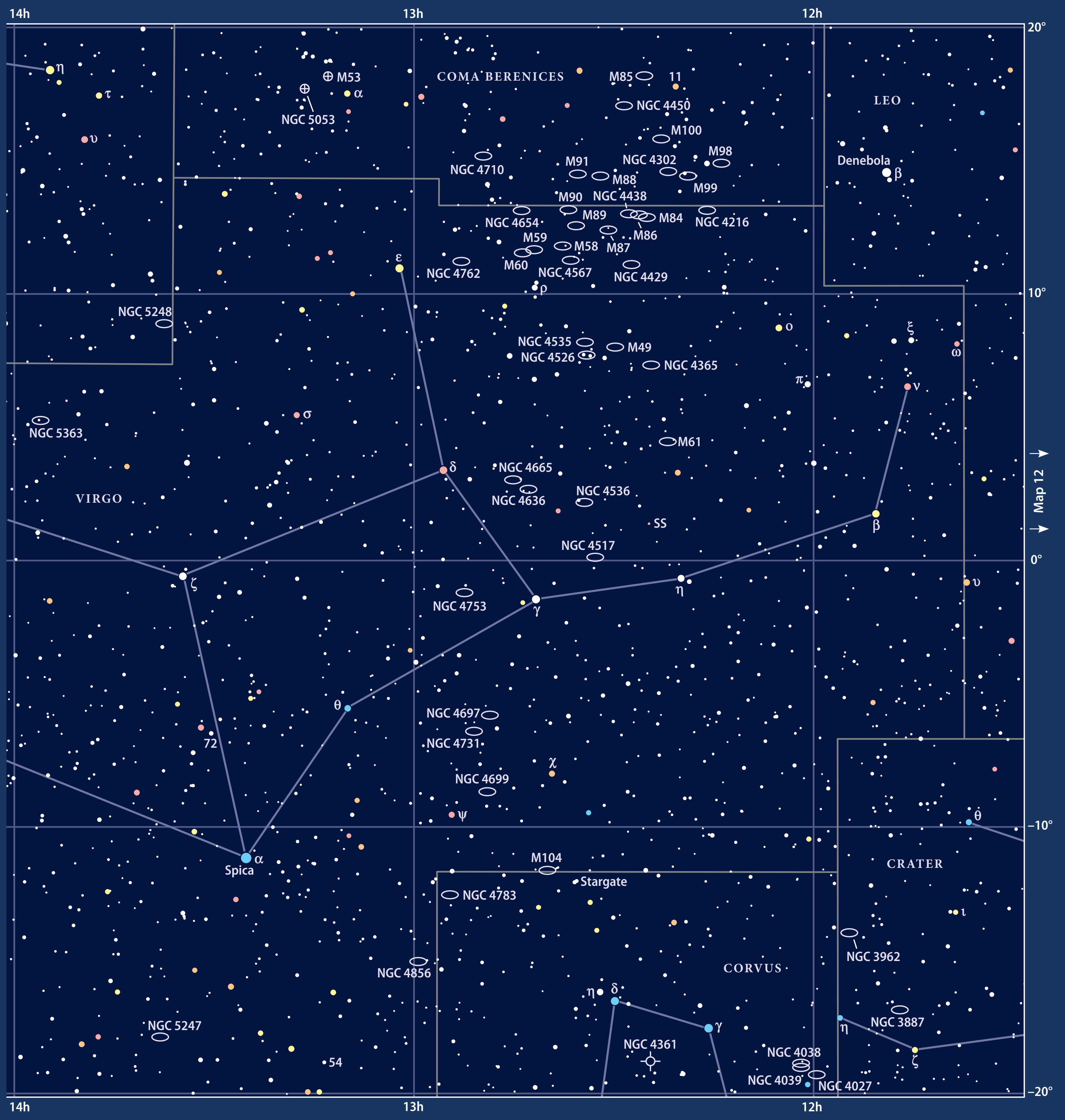
14h
13h
12h
20°
10°
0°
–10°
–20°
Map 12
COMA BERENICES
LEO
VIRGO
CRATER
CORVUS
M53
NGC 5053
M85
11
NGC 4450
M100
M98
NGC 4302
M91
M88
M99
NGC 4710
Denebola
M90
NGC 4438
NGC 4216
NGC 4654
M89
M84
M86
M59
M58
M87
M60
NGC 4762
NGC 4567
NGC 4429
NGC 5248
NGC 4535
M49
NGC 4526
NGC 4365
NGC 5363
M61
NGC 4665
NGC 4636
NGC 4536
SS
NGC 4517
NGC 4753
NGC 4697
NGC 4731
72
NGC 4699
Spica
M104
Stargate
NGC 4783
NGC 3962
NGC 4856
NGC 3887
NGC 5247
NGC 4361
NGC 4038
NGC 4039
NGC 4027
54
η
τ
υ
α
β
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ρ
ο
ξ
ω
π
ν
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δ
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η
ζ

◌ Open cluster

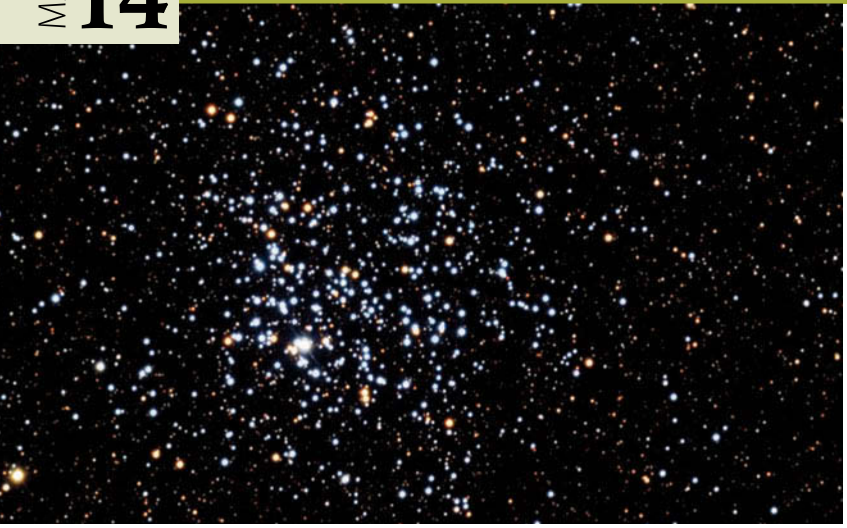
⊕ Globular cluster

□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha
β	Beta
γ	Gamma
δ	Delta
ε	Epsilon
ζ	Zeta
η	Eta
θ	Theta
ι	Iota
κ	Kappa
λ	Lambda
μ	Mu
ν	Nu
ξ	Xi
ο	Omicron
π	Pi
ρ	Rho
σ	Sigma
τ	Tau
υ	Upsilon
φ	Phi
χ	Chi
ψ	Psi
ω	Omega



ADAM BLOCK/NOAO/AURA/NSF

▲ THE WILD DUCK CLUSTER (M11) swarms with stars. Use 80x to 100x through an 8-inch or larger telescope for the best view.

Globular central

If Map 13 contains the realm of the galaxies, then the next map encompasses the realm of globular clusters. Our Milky Way contains roughly 200 globular clusters, and a third of them can be found in just 3 of the 88 constellations: Scorpius, Sagittarius, and Ophiuchus. (Ophiuchus occupies a large part of the next map. Find Scorpius and Sagittarius on Map 20.) But this region contains more than just globulars.

Because the Milky Way passes through Sagitta, Aquila, Scutum, Serpens, and part of Ophiuchus, open clusters and nebulae abound here. You won't find many galaxies, however. The reason is the composition of the Milky Way itself. In addition to stars, immense diffuse gas clouds and dust permeate our galaxy's spiral arms (which we see at night as the Milky Way). This material blocks out light from more distant stars and galaxies. The drop-off in numbers of observable galaxies is so extreme that early 20th-century astronomers referred to this area as the Zone of Avoidance.

In Sagitta, find globular cluster **M71** midway between Gamma and Delta Sagittae. This 8th-magnitude cluster looks irregular at low power because of foreground stars. Through a 6-inch scope, you can resolve a couple dozen stars, and the view doesn't improve much through a 12-inch — only 50 stars are visible within a 4' area.

Below Sagitta, Aquila provides an opportunity to view an easily recognized dark nebula. About 1° west of Gamma Aquilae lies a complex of dark nebulae known as Barnard's E. Dark nebulae are not voids, as astronomers once believed, but rather clouds of dust and cold gas that block out light from more distant stars. American astronomer Edward Emerson Barnard cataloged hundreds of these objects strewn across the bright background of the Milky Way.

Use binoculars or a low-power eyepiece in your telescope to see Barnard 143, which forms a prominent C shape roughly 20' long oriented east-west. Just to the south lies Barnard 142, a ½°-long stretch of dark nebulosity. Together, these two form the E, which stands out well because the arms of our galaxy that form the background are full of faint stars.

Not quite 4° north-northwest of Delta Aquilae lies planetary nebula **NGC 6781**. Through an 8-inch telescope, this magnitude 11.4 object spans more than 1.5' and stands out well against a star-filled background. For best results, use a 6-inch or larger telescope and a nebula filter, and look for NGC 6781's irregularly illuminated outer edge.

Now look a bit more than 4° southwest of Delta Aquilae for globular cluster **NGC 6760**. Glowing at magnitude 9.1, NGC 6760 is a concentrated globular cluster you easily will spot through a 3-inch scope. Even a 12-inch telescope doesn't resolve more than a handful of the globular's stars, but this size scope does show the cluster as mottled.

Southwest of Aquila lies the small constellation Scutum the Shield. Aquila contains 6 times more area than Scutum, but Aquila contains no Messier objects, and Scutum has two.

Nearly 2° southeast of Beta Scuti lies the **Wild Duck Cluster** (M11). This magnificent open cluster measures about 12' across and shines at magnitude 5.8, making it visible to your naked eyes from a dark site. M11 acquired its odd name when 19th-century observer William Henry Smyth wrote that it resembled a flock of wild ducks in flight. Smyth was referring to the cluster's triangular shape. Through a 6-inch telescope, you'll see more than 100 stars, many of them packed into the dense core. The brightest star shines at 8th magnitude and lies near M11's center.

BORN UNDER A BAD SIGN: ASTROLOGY

The most frequently asked question in astrology must be, "What's your sign?" Usually, this means, "What's your Sun sign?" More specifically, the question asks, "In which sign of the zodiac was the Sun on the date of your birth?" The answer is not as simple as it may appear.

Astrologers divide the zodiac into twelve equal parts called "signs." Each sign represents a space in the zodiac ruled by one of the twelve constellations. According to astrologers, the Sun is "in" each sign for about 30 days.

This system gives us the familiar horoscope table — the one you see in some newspapers. According to that table, a person born November 10 is under the sign of Scorpio. But when we look in the sky on November 10, the Sun is not in the constellation Scorpius at all — it's in Libra the Scales. Which set of characteristics should we expect in this person, those of the Scorpion or those of the Scales?

If we examine all the signs of the zodiac, we find the same problem: The Sun occupies the space in the zodiac assigned to the previous sign's constellation.

It wasn't always this way. Approximately 1,800 years ago, when the birth dates corresponding to each Sun sign were determined, the signs did correspond fairly well to the constellations. Since then, however, they've shifted almost 25°.

The reason for this shift is a peculiar motion of Earth called precession. Because of gravitational influences from the Sun and Moon, Earth's axis wobbles like that of a dying top. But Earth is large, so the wobble is slow. It takes 26,000 years for our planet to complete one precessional cycle, or one complete wobble.

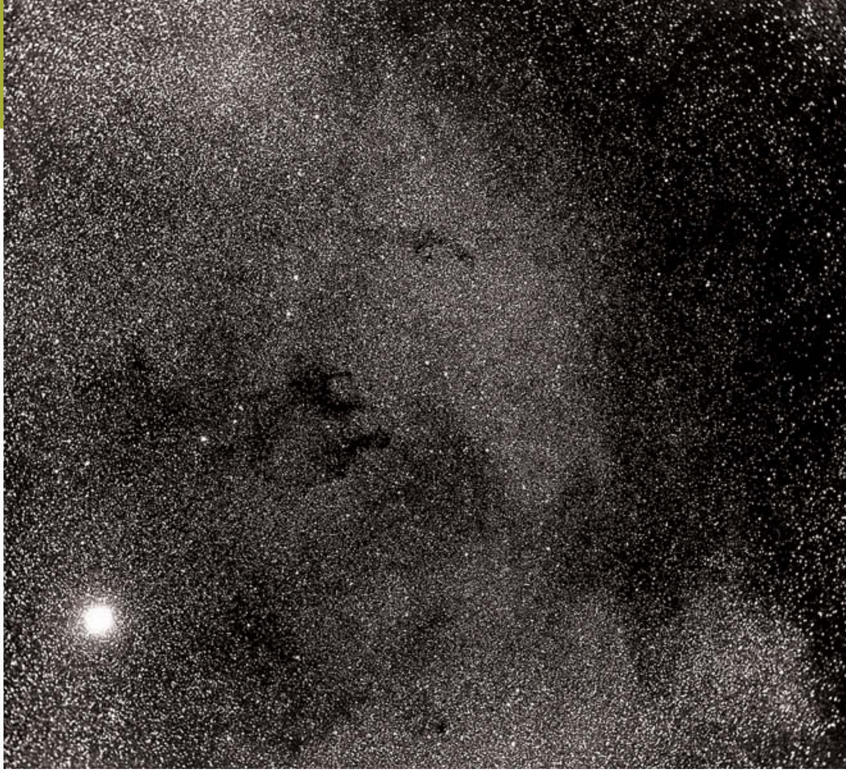
Since the days of ancient Greece, precession has carried all the zodiacal signs nearly one constellation to the west. The precessional shift will continue, and the error will increase every year until 24,000 years from now, when the signs will once again match the constellations they are named for.

If you ask a modern astrologer about precession, he or she will probably tell you that it just doesn't matter — the *signs* are important, not the constellations. But, without the constellations, where do the signs get their magical powers?

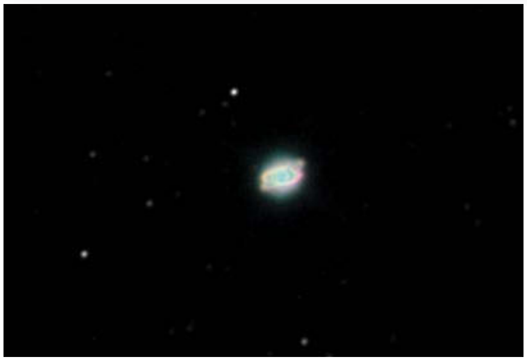
Without Scorpius the Scorpion, what is scorpion-like about the sign Scorpio? What's bullish about the sign Taurus without the constellation Taurus the Bull? How can we believe in influences from the stars if astrologers themselves say the stars are irrelevant? The simple answer is, we can't.

/// DOUBLE-STAR DELIGHTS — MAP 14

Designation	Right ascension	Declination	Magnitudes	Separation
KUI 70	16h06m	–6°09'	6.5, 12.3	9.3"
Kappa Herculis	16h08m	17°03'	6.3, 6.5	28.1"
Omega Herculis	16h25m	14°02'	4.5, 11.0	28.4"
37 Herculis	16h41m	4°13'	5.8, 7.0	9.7"
19 Ophiuchi	16h47m	2°04'	6.1, 9.4	23.4"
Alpha Herculis	17h15m	14°23'	3.5, 5.4	4.8"
61 Ophiuchi	17h45m	2°35'	6.2, 6.6	20.6"
Struve 2325	18h31m	–10°48'	5.8, 9.3	2.3"
Delta Scuti	18h42m	–9°03'	4.7, 12.2	15.2"
5 Aquilae	18h46m	–0°58'	5.7, 6.1, 7.9	12.8", 26.3"
11 Aquilae	18h59m	13°37'	5.4, 8.9	17.8"
HO 275	19h51m	–10°46'	5.4, 13.6	21.1"
Beta Aquilae	19h55m	6°24'	3.9, 11.8	12.9"
Struve 2644	20h13m	0°52'	6.9, 7.1	2.7"



▲ **BARNARD'S E** (B142 and B143) lies a bit more than 3° northwest of Altair (Alpha Aquilae). Use binoculars or a wide-field eyepiece in your telescope to view this area. FROM *A PHOTOGRAPHIC ATLAS OF SELECTED REGIONS OF THE MILKY WAY*



BRUCE BODNER/ADAM BLOCK/NOAO/AURA/NSF

▲ **PLANETARY NEBULA** NGC 6572 in Ophiuchus shines at magnitude 8.1. You won't see much detail, but NGC 6572's green color makes it a popular target.

MICHAEL GARIEPY/ADAM BLOCK/NOAO/AURA/NSF

▲ **M12** in Ophiuchus is one of the least concentrated globular clusters. Use high magnification to compare it to M10, at right.

MICHAEL AND MICHAEL McGUIGGAN/ADAM BLOCK/NOAO/AURA/NSF

▲ **GLOBULAR CLUSTER** M10 in Ophiuchus shines at magnitude 6.6, making it one of the sky's brightest globulars.

M26 is Scutum's other Messier object. M26 is also an open cluster, but fainter (magnitude 8.0) and looser than M11. A 4-inch telescope reveals 25 stars within a 10' area, and a 12-inch scope will triple that number.

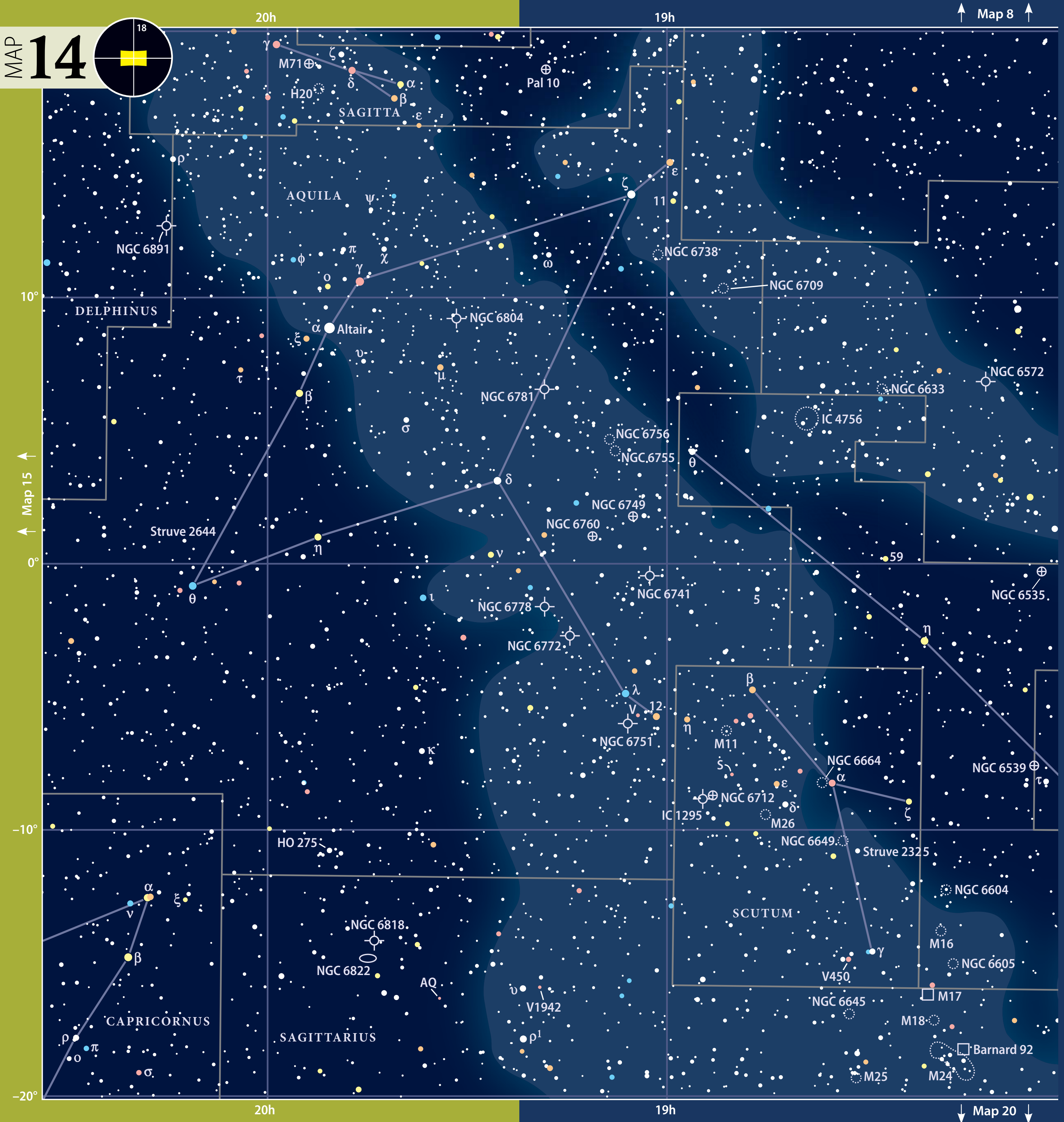
The lone galaxy of note on Map 14 — **Barnard's Galaxy** (NGC 6822) — is also a challenge to see. The galaxy's magnitude of 8.8 is misleading because the light spreads out over an area 19' by 15'. Not many bright stars reside near NGC 6822. This object lies more than 6° northeast of Rho^1 Sagittarii. Use low power under a dark sky, and look for a roughly rectangular haze slightly brighter than the background.

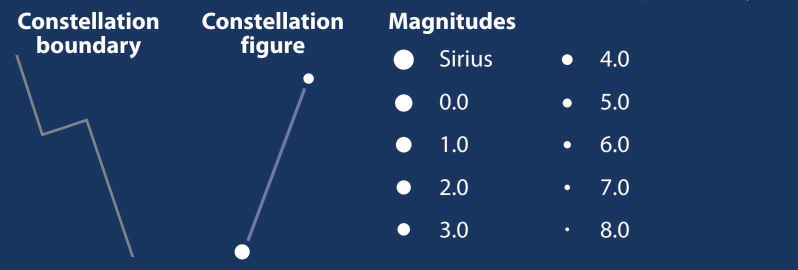
Ophiuchus contains no less than 10 globular clusters brighter than magnitude 9. Seven belong to Messier's catalog: **M9**, **M10**, **M12**, **M14**, **M19** (Map 20), **M62** (Map 20), and **M107.** Three do not: magnitude 8.2 **NGC 6293** (Map 20), magnitude 8.2 **NGC 6356**, and magnitude 8.9 **NGC 6366**. Each of these globular clusters offers a unique observing experience. For example, compare M10 and M12. Move from one to the other and back again. View them at low power against a wide background. Then, view them at as high of a magnification as conditions allow. By noting the similarities and differences, you'll become a better observer.

BILL LOFQUIST/ADAM BLOCK/NOAO/AURA/NSF

▲ **THE EAGLE NEBULA** (M16) is a bright emission nebula associated with a prominent open star cluster (not shown). Use an OIII filter for best results.

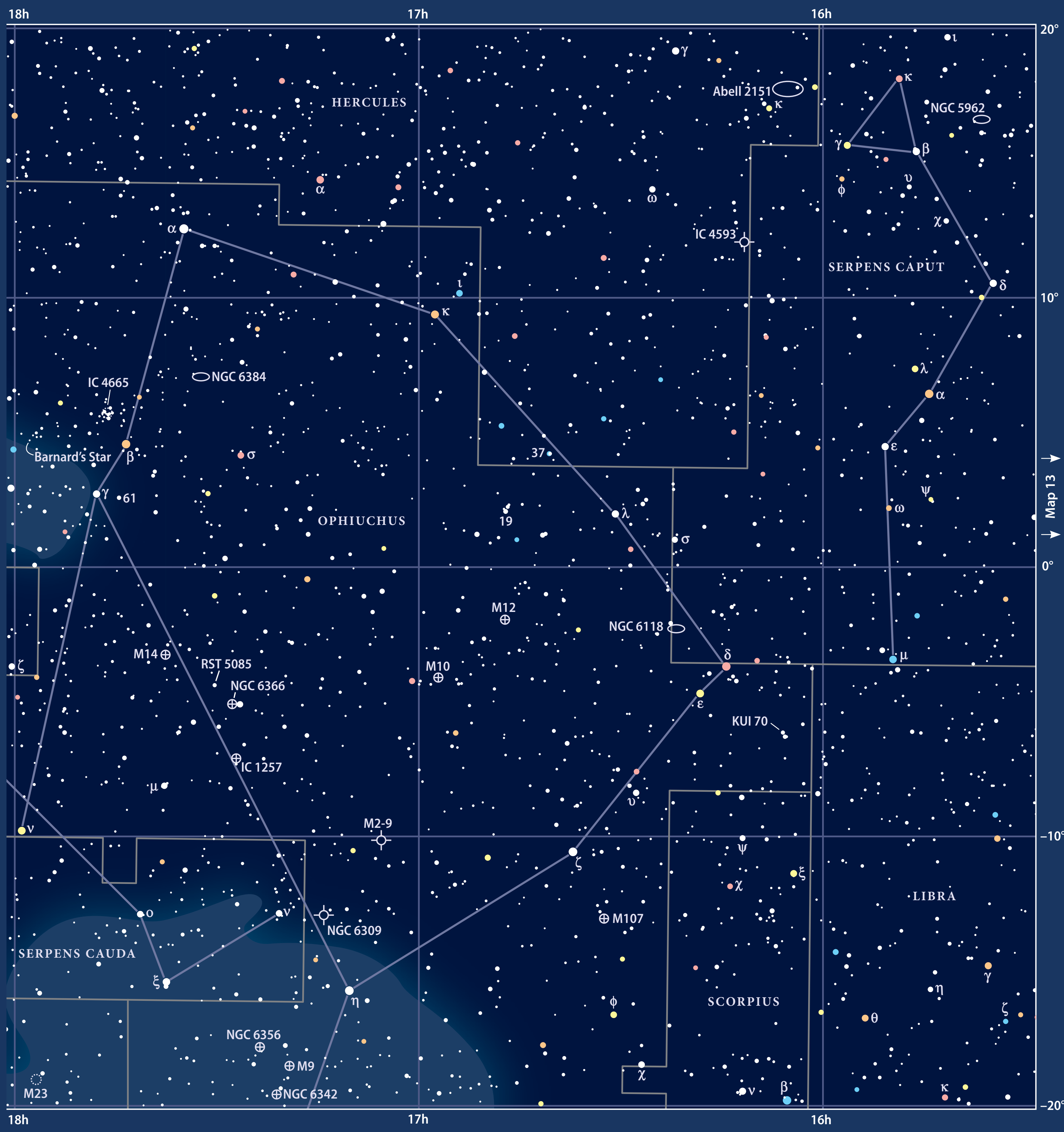
MAP 14


18
20h
19h
Map 8
Map 15
Map 20
10°
0°
–10°
–20°
SAGITTA
AQUILA
DELPHINUS
SCUTUM
CAPRICORNUS
SAGITTARIUS
M71
H20
Pal 10
Altair
NGC 6891
NGC 6804
NGC 6738
NGC 6709
NGC 6781
NGC 6756
NGC 6755
NGC 6749
NGC 6760
NGC 6741
NGC 6778
NGC 6772
NGC 6751
NGC 6633
NGC 6572
IC 4756
NGC 6535
NGC 6539
NGC 6664
NGC 6712
IC 1295
M11
M26
NGC 6649
Struve 2325
Struve 2644
NGC 6604
M16
NGC 6605
M17
M18
Barnard 92
M24
M25
NGC 6645
V450
V1942
NGC 6818
NGC 6822
AQ
HO 275
11
12
5
59


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

EQUATORIAL REGION 5

Use this map in early evenings during mid-summer north of the equator and mid-winter in the Southern Hemisphere.


18h
17h
16h
20°
ι
γ
Abell 2151
κ
κ
NGC 5962
HERCULES
γ
β
α
ω
ϕ
υ
χ
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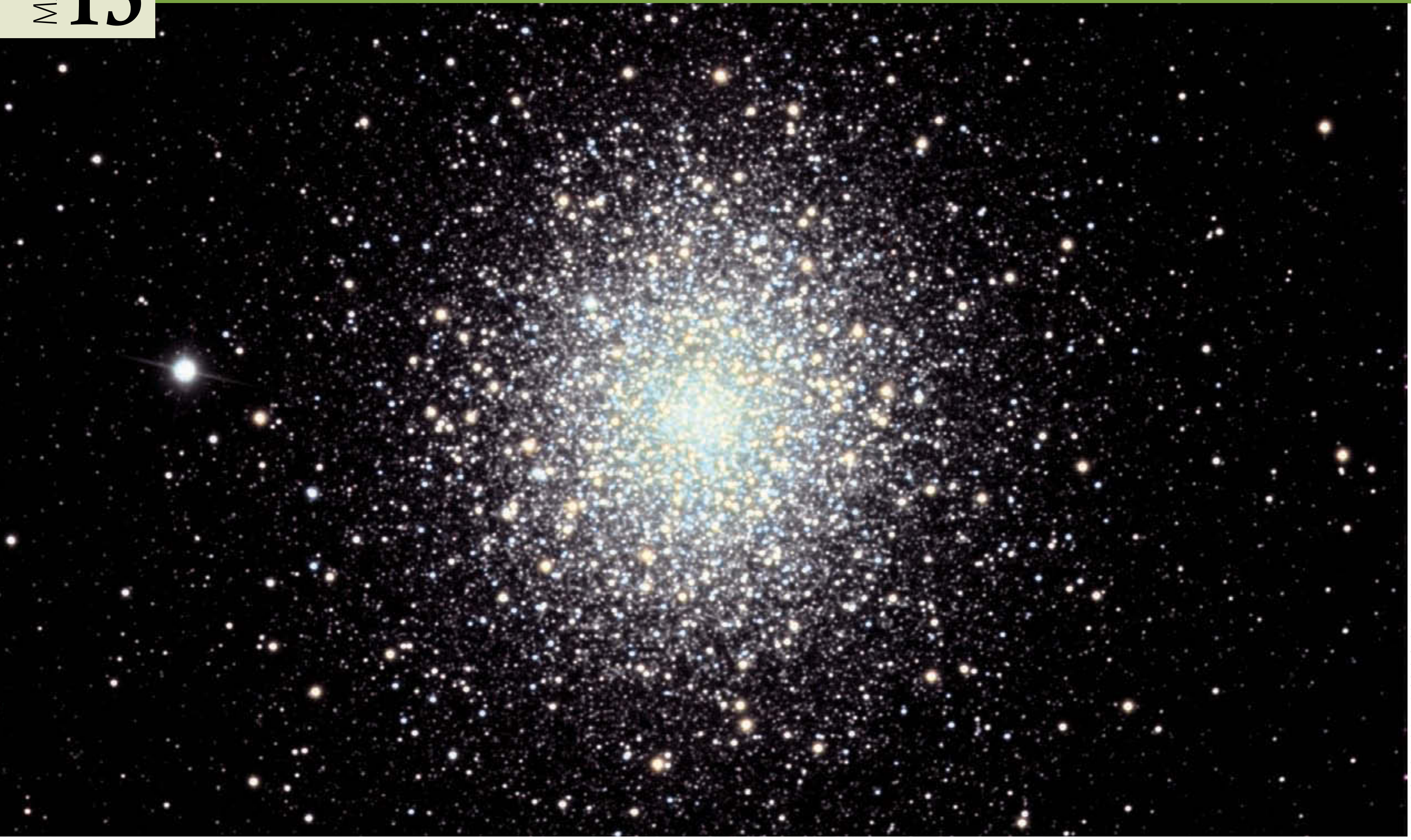
IC 4593
SERPENS CAPUT
δ
10°
ι
κ
NGC 6384
IC 4665
λ
α
Barnard's Star
β
σ
37
ε
γ
61
OPHIUCHUS
19
λ
σ
ψ
ω
Map 13
0°
M12
NGC 6118
δ
μ
ζ
M14
RST 5085
NGC 6366
M10
ε
KUI 70
IC 1257
μ
υ
ν
M2-9
ψ
ξ
–10°
ζ
χ
LIBRA
ο
ν
NGC 6309
M107
SERPENS CAUDA
ξ
η
γ
η
ϕ
SCORPIUS
θ
ζ
NGC 6356
M9
χ
ν
β
κ
M23
NGC 6342
–20°
18h
17h
16h

◌ Open cluster
⊕ Globular cluster
☐ Diffuse nebula
⌖ Planetary nebula
⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	ϕ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega



PAT AND CHRIS LEE/ADAM BLOCK/NOAO/AURA/NSF

▲ **M2 IN AQUARIUS** **is one of the sky's richest and most compact globular clusters. Through a telescope, M2 appears slightly elliptical.**

Swimming with stars

The next star map includes part of the sky's so-called watery region, so called by early observers. It contains Delphinus the Dolphin and the northern parts of Aquarius the Water-bearer, Capricornus the Sea Goat, Cetus the Whale, and some of Pisces the Fish. Not shown — but nearby — are Piscis Austrinus the Southern Fish and Eridanus the River. Combined, these constellations cover more than 10 percent of the sky.

In Delphinus, the standout deep-sky object is globular cluster **NGC 6934**. This object shines at magnitude 8.7. Find it by dropping 4° south from Epsilon Delphini. NGC 6934 measures more than 8' across, but to see it to that extent, you'll need a 16-inch telescope. More modest instruments show it as 3' in diameter. You may pick out a few outlying stars, but its central region remains unresolved.

Apart from a few double stars, Equuleus the Little Horse contains no deep-sky objects of interest. But the other horse — Pegasus — boasts quite a few. The best is globular cluster **M15**. This magnitude 6.3 object measures more than 10' across. You can spot M15 with your naked eyes, but don't confuse it with the star SAO 107195, which lies only 17' to the east. Through a 6-inch or larger telescope, you'll see several hundred stars in a variety of patterns scattered about M15's dense, unresolved core.

Aquarius boasts three Messier objects. **M72** lies nearly 3.5° south-southeast of magnitude 3.8 Epsilon Aquarii. M72 glows at magnitude 9.2 and measures approximately 5' across. The cluster is so dense that you won't be able to resolve any stars near its core.

Only 1.3° east of M72 lies **M73**. Most lists classify M73 as an open cluster, but it consists of only four stars: a nearly equilateral triangle of 10th- and 11th-magnitude stars with a fainter companion to the west. Check out M73, cross it off your Messier list, and move on.

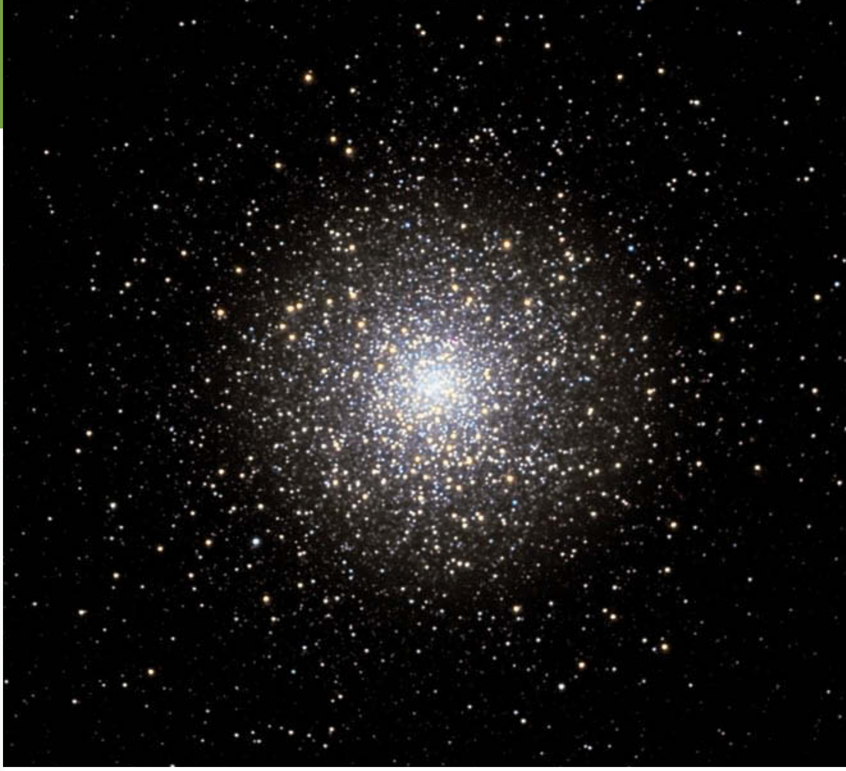
If you observe Aquarius' third Messier object next, you may think it's in a different class than M72 and M73. Globular cluster **M2** is a showpiece. To find it, scan roughly 4.5° due north of Beta Aquarii. If you have sharp eyes, you'll see this magnitude 6.6 cluster without optical aid from a dark site. A superb object in any telescope, M2 displays hundreds of stars through 10-inch and larger instruments.

Slightly more than 1° west of Nu Aquarii lies the **Saturn Nebula** (NGC 7009). Its name arises from the extensions, or ansae, at either end of the planetary nebula's disk that roughly resemble Saturn's rings. The extensions measure 15" past the ends of the 25"-long oval disk. At the end of the extensions are fainter bulbs you'll have trouble seeing through a 10-inch scope. Whether you see NGC 7009 as mainly blue or mainly green depends on your color perception.

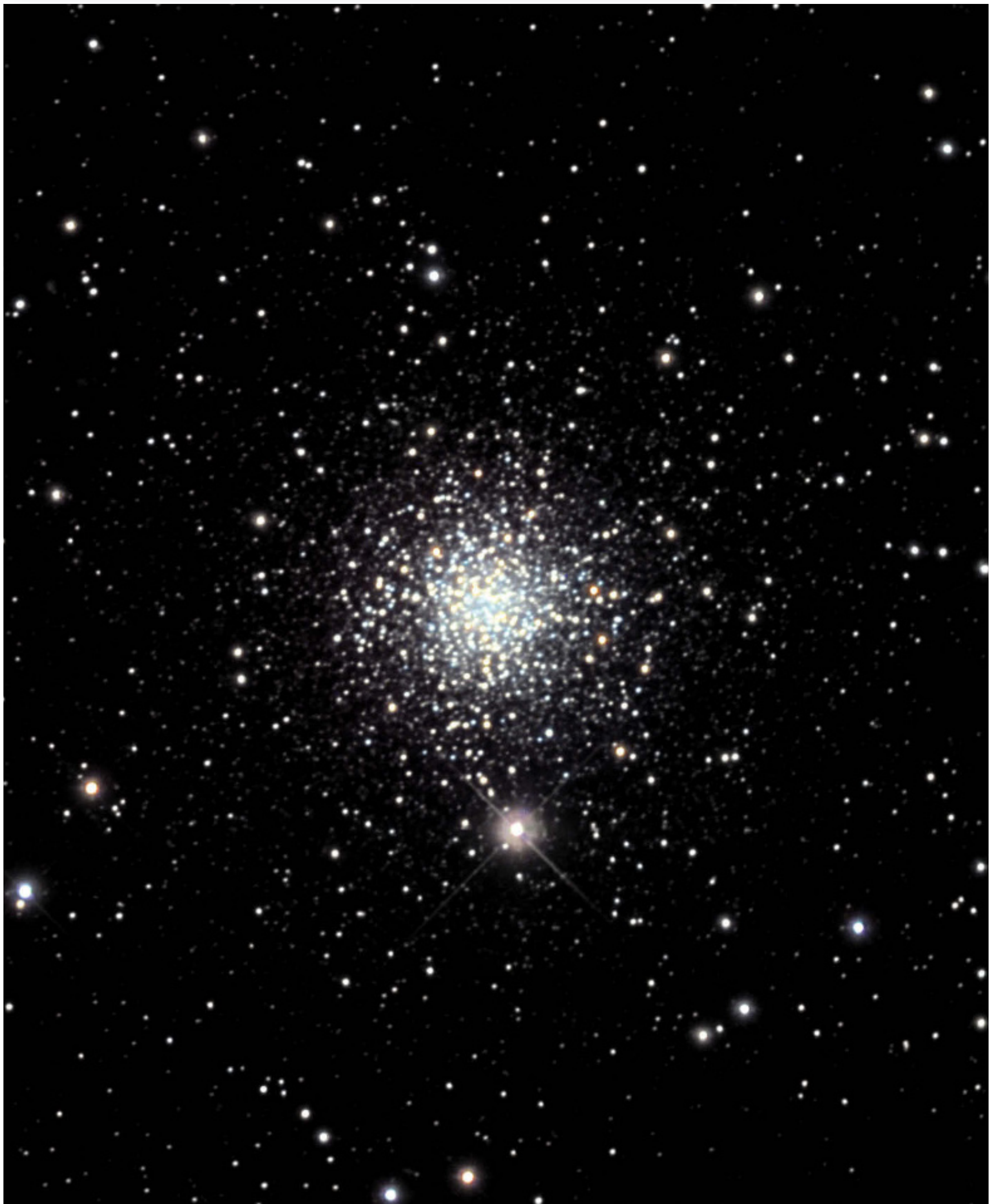
While you're observing in Aquarius, don't miss the **Helix Nebula** (NGC 7293), which lies on Map 21. This magnitude 7.3 planetary nebula measures 13' across. Counteract its low surface brightness by using a nebula filter. With a filter in place, you'll see the ring structure through a telescope as small as 4 inches in aperture. Through a 12-inch scope, you may see slightly brighter concentrations on the north and south edges.

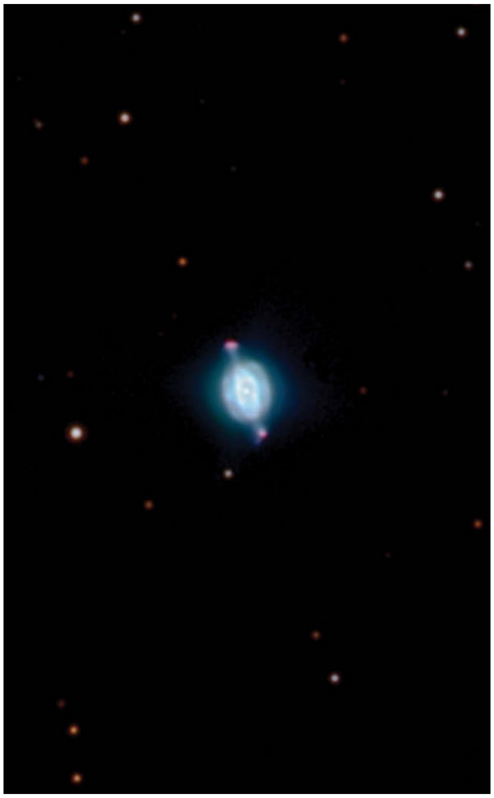
DOUBLE-STAR DELIGHTS — MAP 15

Designation	Right ascension	Declination	Magnitudes	Separation
Alpha^2 Capricorni	20h18m	–12°32'	3.8, 11.2	6.6"
Pi Capricorni	20h27m	–18°12'	5.2, 8.8	3.4"
Omicron Capricorni	20h30m	–18°35'	6.1, 6.6	18.9"
Gamma Delphini	20h47m	16°08'	4.5, 5.5	9.6"
4 Pegasi	21h39m	5°46'	5.8, 11.8	27.2"
30 Pegasi	22h20m	5°47'	5.4, 10.7	6.2"
34 Pegasi	22h27m	4°23'	5.8, 12.3	3.4"
Xi Pegasi	22h47m	12°10'	4.3, 12.3	11.5"
Tau^1 Aquarii	22h48m	–14°03'	5.8, 9.0	22.6"
94 Aquarii	23h19m	–13°27'	5.1, 7.5	12.6"
STF 3009	23h24m	3°42'	6.8, 8.8	7.0"
Omega^2 Aquarii	23h43m	–14°31'	4.6, 10.6	5.3"
107 Aquarii	23h46m	–18°40'	5.8, 6.8	6.6"



▲ **GLOBULAR CLUSTER** M15 in Pegasus is bright enough for you to glimpse with your naked eyes from a dark site. ADAM BLOCK/NOAO/AURA/NSF

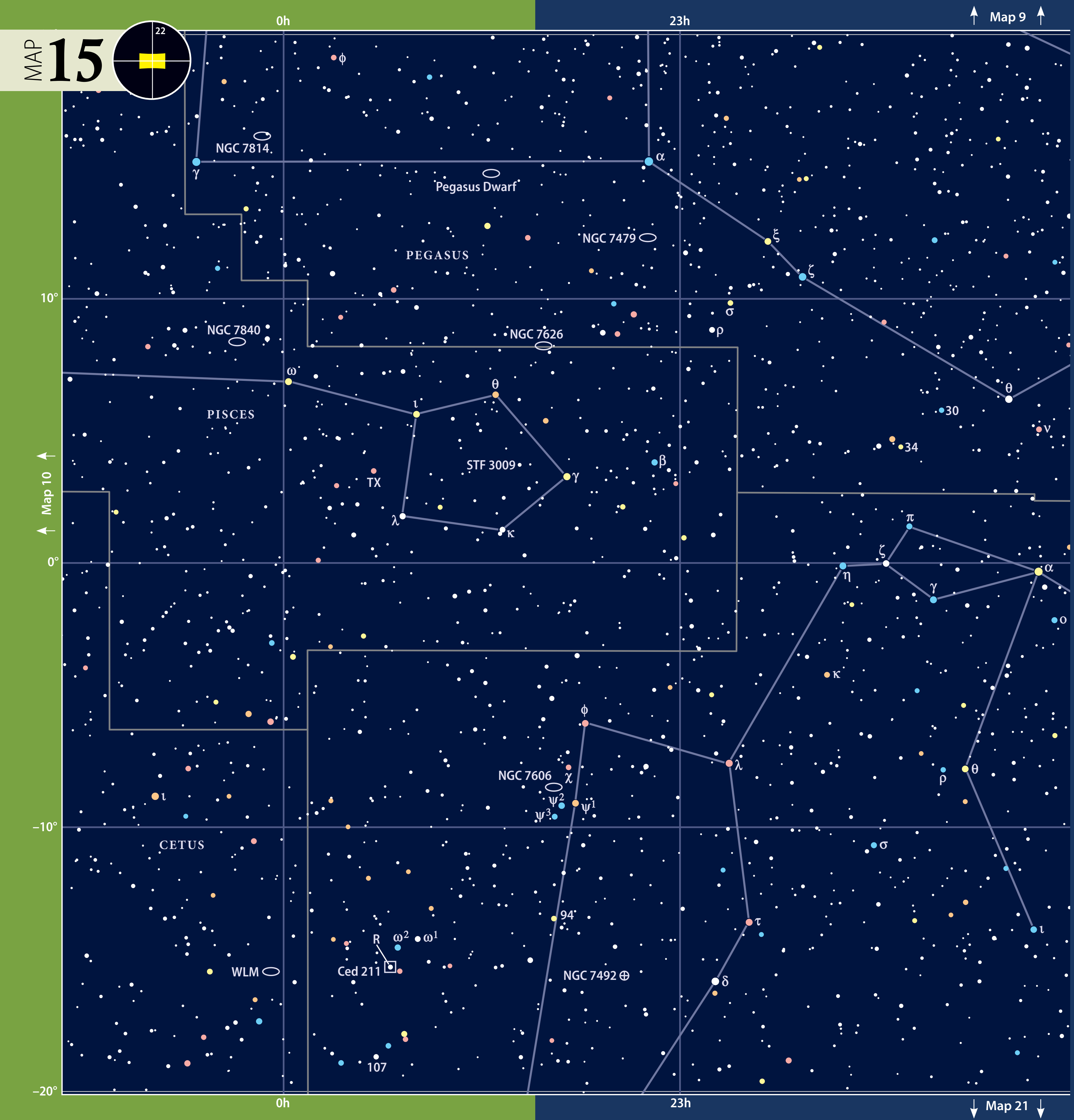




DALE NIKSCH/ADAM BLOCK/NOAO/AURA/NSF

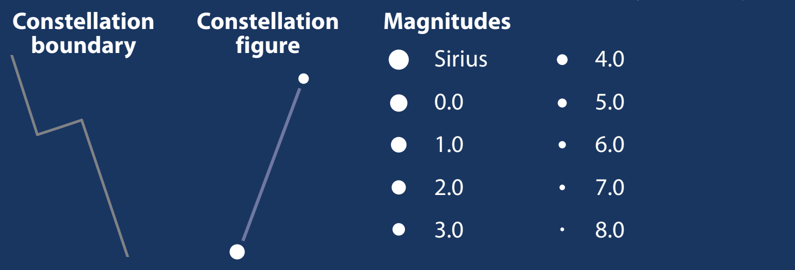
▲ **THE SATURN NEBULA** (NGC 7009) was the first deep-sky object discovered by English astronomer William Herschel (1738–1822). He found it in 1782. NGC 7009 shines at 8th magnitude and measures 1.6' by 0.4'.

◀ **GLOBULAR CLUSTER** NGC 6934 in Delphinus spans 8.4'. While outlying stars are easy to resolve, you won't see many individual stars as you move toward the core. DANIEL VERSCHATSE


MAP 15
22
0h
23h
Map 9
10°
0°
−10°
−20°
Map 10
φ
NGC 7814
γ
α
Pegasus Dwarf
PEGASUS
NGC 7479
ξ
ζ
σ
ρ
NGC 7840
NGC 7626
ω
θ
ι
PISCES
θ
30
ν
34
STF 3009
γ
β
TX
λ
κ
π
ζ
η
α
γ
o
κ
φ
λ
NGC 7606
χ
ψ2
ψ1
ψ3
θ
ρ
ι
CETUS
σ
94
τ
R
ω2
ω1
ι
WLM
Ced 211
NGC 7492
δ
107
0h
23h
Map 21

EQUATORIAL REGION 6

View these constellations and deep-sky objects best during late summer in the Northern Hemisphere and late winter south of the equator.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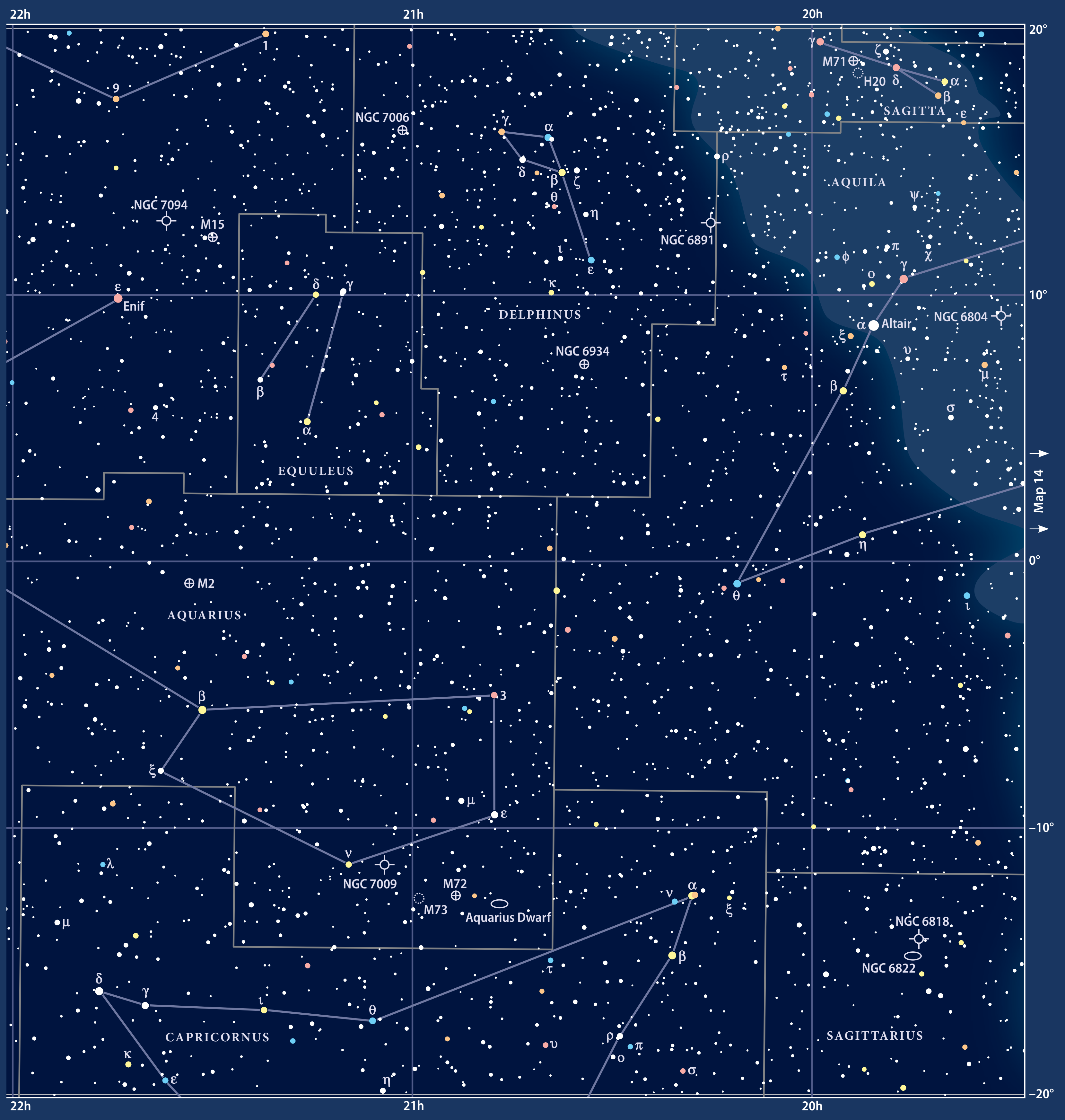
22h
21h
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–20°
Map 14
1
9
NGC 7006
NGC 7094
M15
Enif
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4
δ
γ
β
α
EQUULEUS
γ
α
δ
β
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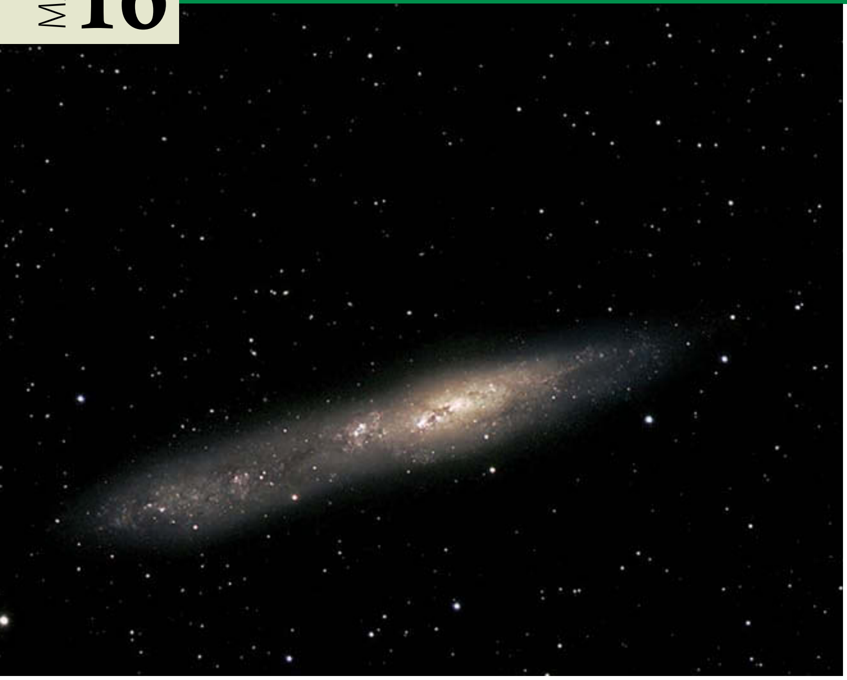
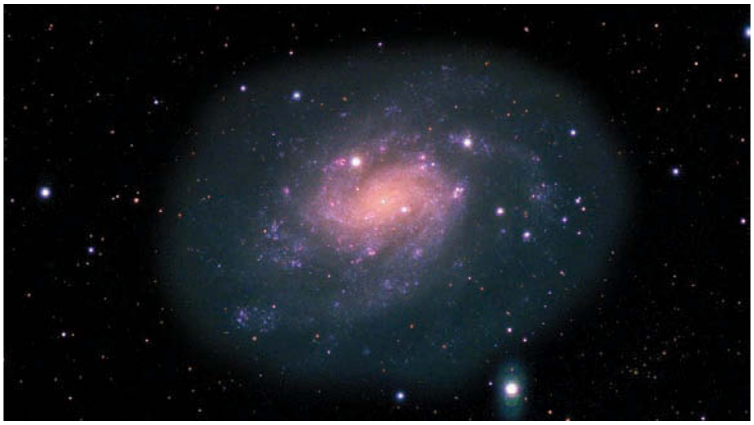
θ
η
ι
ε
κ
DELPHINUS
NGC 6934
NGC 6891
ρ
γ
M71
ζ
H20
δ
α
β
SAGITTA
ε
AQUILA
ψ
π
φ
χ
ο
γ
α
Altair
NGC 6804
ξ
υ
τ
β
μ
σ
η
θ
ι
M2
AQUARIUS
β
3
ξ
μ
ε
ν
NGC 7009
M72
M73
Aquarius Dwarf
ν
α
ξ
β
τ
λ
μ
δ
γ
ι
θ
CAPRICORNUS
κ
ε
η
υ
ρ
π
ο
σ
NGC 6818
NGC 6822
SAGITTARIUS

◌	Open cluster	α	Alpha	η	Eta	ν	Nu	τ	Tau
⊕	Globular cluster	β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
☐	Diffuse nebula	γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
⌖	Planetary nebula	δ	Delta	κ	Kappa	π	Pi	χ	Chi
⬭	Galaxy	ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
		ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega



▲ **THE SOUTHERN CIGAR GALAXY (NGC 55) in Sculptor lies 5 million light-years away. Most of its stars lie to the west of its core.** DANIEL VERSCHATSE



DANIEL VERSCHATSE

▲ **THE SOUTHERN PINWHEEL GALAXY (NGC 300) in Sculptor resembles its northern namesake, M33 in Triangulum.**

The sky's Furnace

As the star maps dip deeper into the southern sky, we start to see constellations unfamiliar to most Northern Hemisphere observers: Fornax the Furnace, Sculptor the Engraver's Tool, Phoenix the Phoenix, and Horologium the Clock. This region's stars are bright, but we're far from the Milky Way, which means galaxies abound.

For starters, insert an eyepiece that will give you at least a 2° field of view, and point your telescope at the **Fornax Dwarf Galaxy**. Move your scope back and forth to bring out a haze just brighter than the background sky. This object doesn't have a corresponding NGC number because observers discovered it much later than 1888, when that catalog was published. This nearby galaxy — it's only 450,000 light-years away — is one of the Milky Way's closest dwarf companions.

If you're having trouble identifying the Fornax Dwarf, look for its brightest globular cluster, which is easier to see. NGC 1049 glows at magnitude 12.6 and is brighter toward its center.

Find the magnitude 4.5 star Beta Fornacis and move 2° north to the barred spiral galaxy **NGC 1097**. The core is this magnitude 9.5 galaxy's bright point, then the bar, which extends in a northwest-to-southeast direction, and finally, the spiral arms. You'll need at least a 12-inch telescope and a dark sky to see this last feature.

Breaking from our galactic treasure hunt, we find planetary nebula **NGC 1360**. Its overall magnitude is a healthy 9.4, but this is spread out over a circle more than 6' across. As with all planetary nebulae, a nebula or OIII filter — which passes wavelengths planetaries emit — helps a lot.

The Virgo cluster of galaxies prominent in the spring sky is the sky's best-known galaxy cluster (see Map 13). Not far behind is the **Fornax galaxy cluster**. Under a dark sky, an 8-inch scope will let you see dozens of galaxies within a several-degree-wide swath of sky.

One of the brightest members of the Fornax cluster is magnitude 9.3 **NGC 1365**, the finest barred spiral galaxy in the sky. Its bar extends 4' in an east-west orientation; the central 2' is the nucleus. An 8-inch telescope easily resolves the spiral arms, of which the northern — extending from the west end of the bar — is the brightest.

The Fornax galaxy cluster's central region spans a scant 2°, but, through a 16-inch telescope, you'll see more than 100 galaxies. Even a 6-inch scope will show several dozen.

Start with NGC 1374. This magnitude 11 galaxy is 2.5' across and has a fainter companion (NGC 1375) 3' to the south. Pan ¼° southeast to reach NGC 1379, a circular elliptical galaxy that also glows at magnitude 11. Move north ½° to NGC 1380. This 10th-magnitude barred spiral shows a 4.5' by 2.5' oval with a 13th-magnitude star just to the west. Nearby, you'll notice magnitude 11.5 NGC 1381 and magnitude 10.8 NGC 1387.

Finally, in the same high-power field of view, you'll see the twin elliptical galaxies NGC 1399 and NGC 1404. Magnitude 8.8 NGC 1399 is the Fornax galaxy cluster's brightest member. It's not quite circular, measuring 6.9' by 6.5'. At magnitude 9.7, NGC 1404 is fainter and one-quarter the size of NGC 1399. NGC 1404 measures 3.3' by 3.0'.

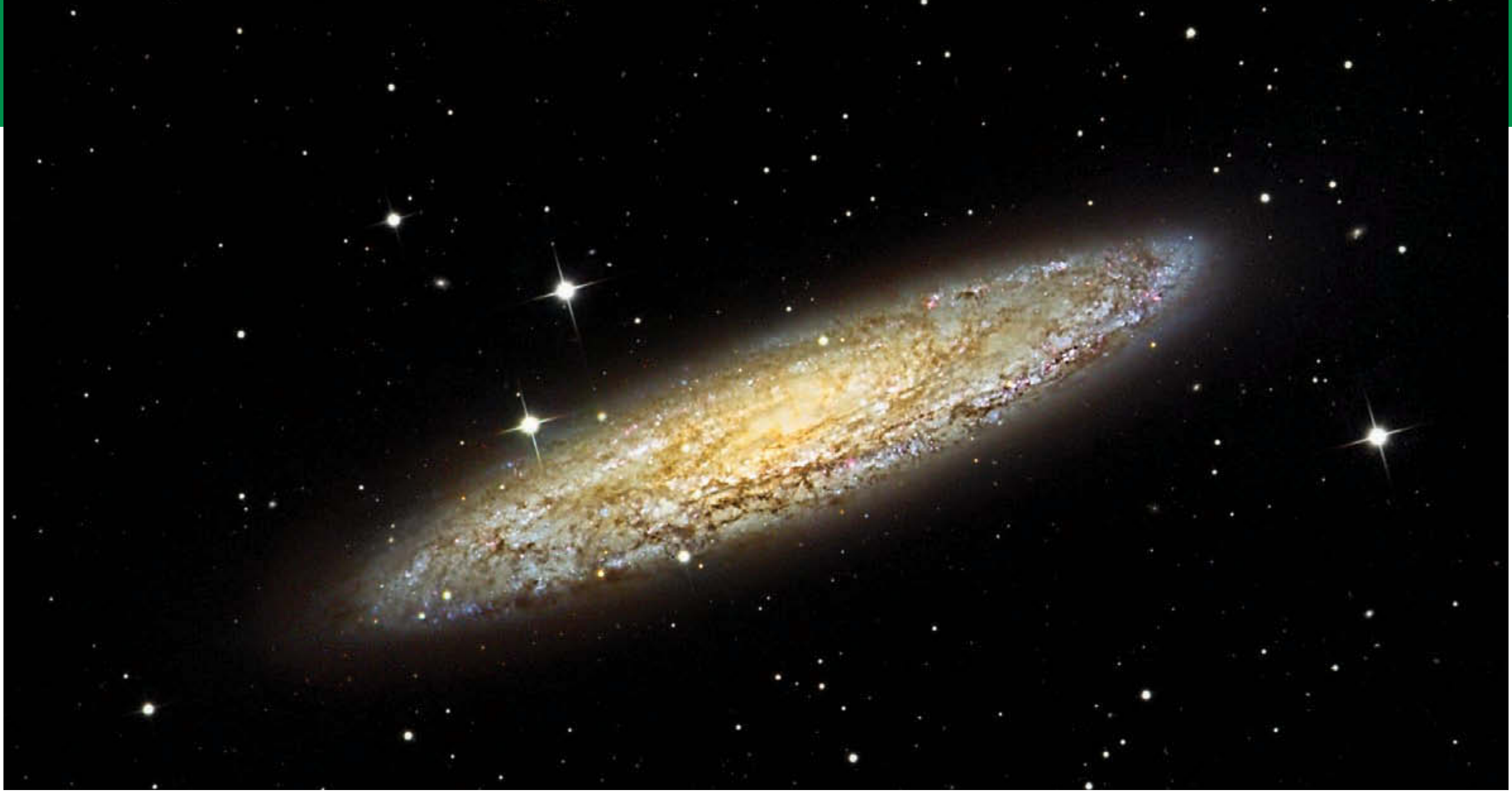
Head south of Fornax into Eridanus and observe the barred spiral galaxy **NGC 1291**. You won't see the bar of this bright (magnitude 8.5) galaxy, but you will see its oval shape and intense core.

A bit more than 2° north of Tau^4 Eridani lies **NGC 1300**, another classic barred spiral galaxy. The core of this magnitude 10.4 object appears oval. The spiral arms glow brightest near the ends of the nucleus's long axis then wind tightly back around the bar.

Now, let's move into Sculptor. When you target objects in this constellation, you'll want to set aside a good portion of the night. You'll find no less than four named galaxies in Sculptor, the highest number contained by any constellation. This quartet also is easy to see — each shines brighter than 9th magnitude.

You can find the **Southern Cigar Galaxy** (NGC 55) about 4° northwest of Alpha Phoenicis. This magnitude 8.1 galaxy lies 5 million light-years away. Nearly ½° long, NGC 55 is unusual because most of its stars are offset west of center, rather than concentrated in its core. This galaxy is one of the few that benefits from a nebula filter. Such a filter suppresses NGC 55's stars, and several large ionized hydrogen clouds pop into view.

Another magnitude 8.1 galaxy in Sculptor is the **Southern Pinwheel Galaxy** (NGC 300), which resembles its northern namesake, the Pinwheel Galaxy (M33) in Triangulum. Because it appears face-on, however, NGC 300 has a much lower surface brightness than NGC 55. To see the spiral arms well, you'll need a wide-field eyepiece on a 12-inch or larger scope.



DANIEL VERSCHATSE

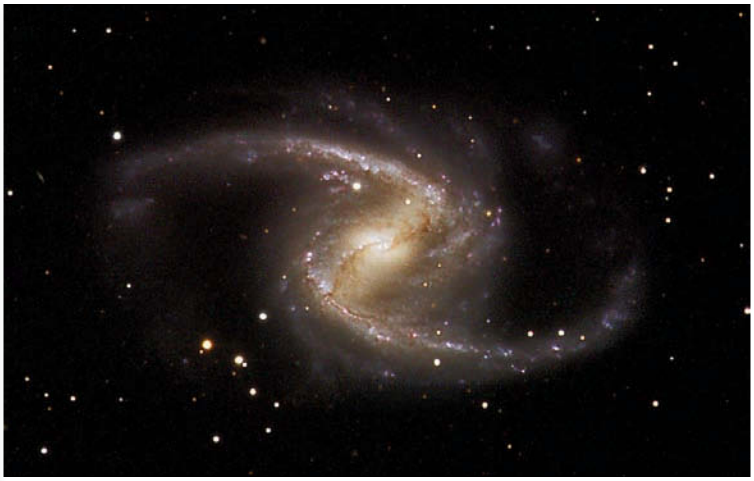
▲ **THE SILVER COIN GALAXY** (NGC 253) in Sculptor shines at magnitude 7.6, bright enough to see with your unaided eyes under ideal conditions.

DOUBLE-STAR DELIGHTS — MAP 16

Designation	Right ascension	Declination	Magnitudes	Separation
HDO 183	0h46m	–47°33'	5.8, 13.5	14.3"
STN 60	1h05m	–33°31'	6.6, 10.6	8.6"
Epsilon Sculptoris	1h46m	–25°02'	5.5, 8.3	4.7"
Chi Eridani	1h56m	–51°36'	3.7, 10.7	4.8"
Omega Fornacis	2h34m	–28°13'	5.0, 7.7	10.9"
Eta^2 Fornacis	2h50m	–35°50'	5.8, 10.0	4.9"
Theta Eridani	2h58m	–40°18'	3.4, 4.5	8.3"
Tau^4 Eridani	3h20m	–21°45'	4.0, 9.5	5.7"
B 1034	3h43m	–37°19'	4.6, 12.2	5.4"
Iota Phoenicis	23h35m	–42°36'	4.8, 12.8	6.7"
HWE 93	23h37m	–31°52'	6.5, 9.8	5.4"
Theta Phoenicis	23h40m	–46°38'	6.6, 7.2	3.9"
Delta Sculptoris	23h49m	–28°07'	4.6, 11.6	3.8"

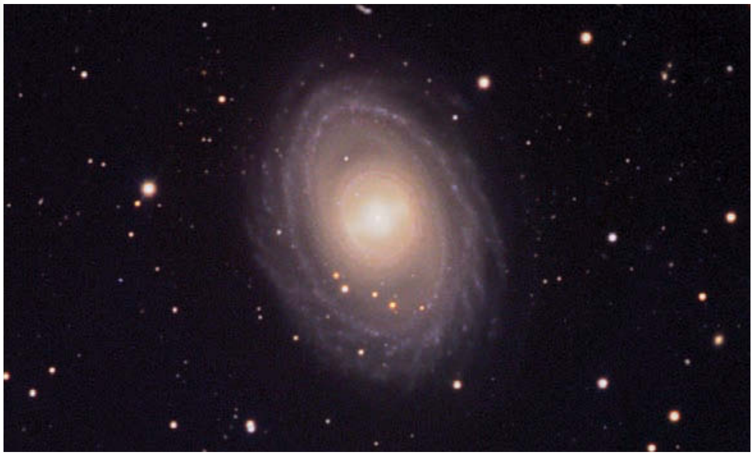
The **Sculptor Dwarf Galaxy**, like the Fornax Dwarf, belongs to the Local Group of galaxies. Lying only 250,000 light-years away, the Sculptor Dwarf shines at magnitude 8.8. Don't let that brightness fool you, however. The Sculptor Dwarf stretches over 1.1° of sky, so its surface brightness is low. Use a wide-angle eyepiece in an 8-inch scope under a dark sky, and look for a diffuse haze just brighter than the background. It lies 2.3° south-southwest of magnitude 5.5 Sigma Sculptoris.

Sculptor's fourth named star system is the **Silver Coin Galaxy** (NGC 253), the showpiece deep-sky object in this region of sky. Observers with superb vision may see the magnitude 7.6 glow of this object with unaided eyes under perfect conditions and if NGC 253 is high enough in the sky. Prepare to spend some quality time at your telescope, and change eyepieces frequently to get the most out of observing this galaxy.



DANIEL VERSCHATSE

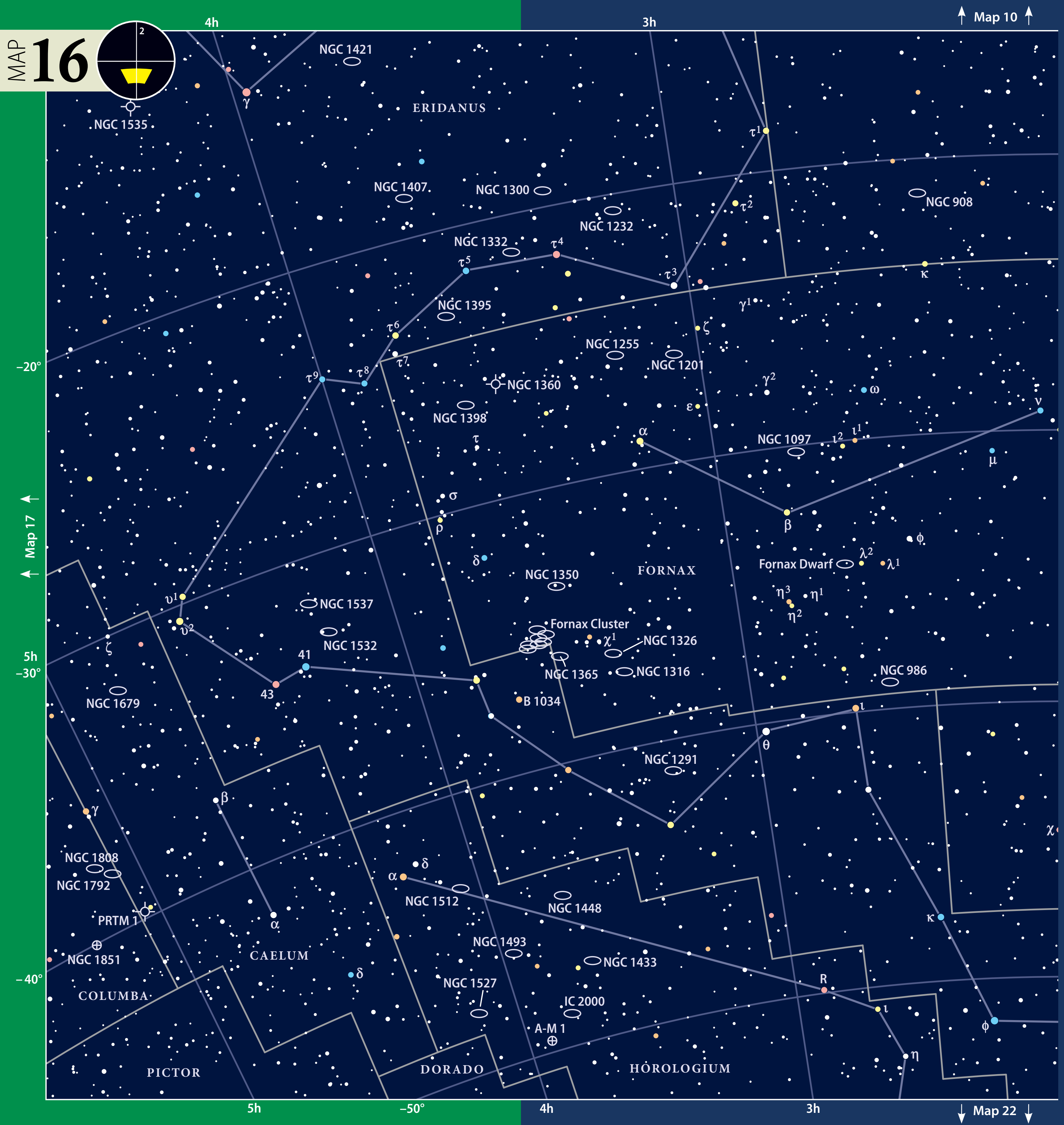
▲ **NGC 1365** in Fornax rates as the sky's finest barred spiral galaxy. It shines at magnitude 9.3 and measures 8.9' by 6.5'.



DANIEL VERSCHATSE

▲ **NGC 1398** in Fornax is a bright, large, tightly wound magnitude 9.7 spiral galaxy that measures 7.2' by 5.2'.

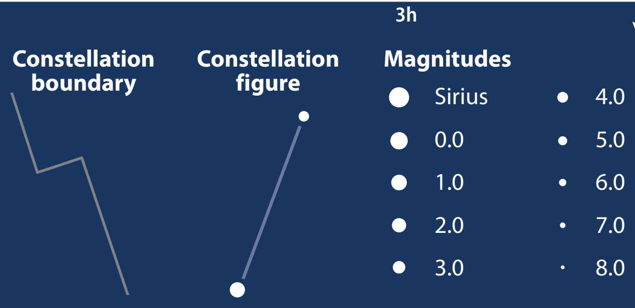
MAP 16



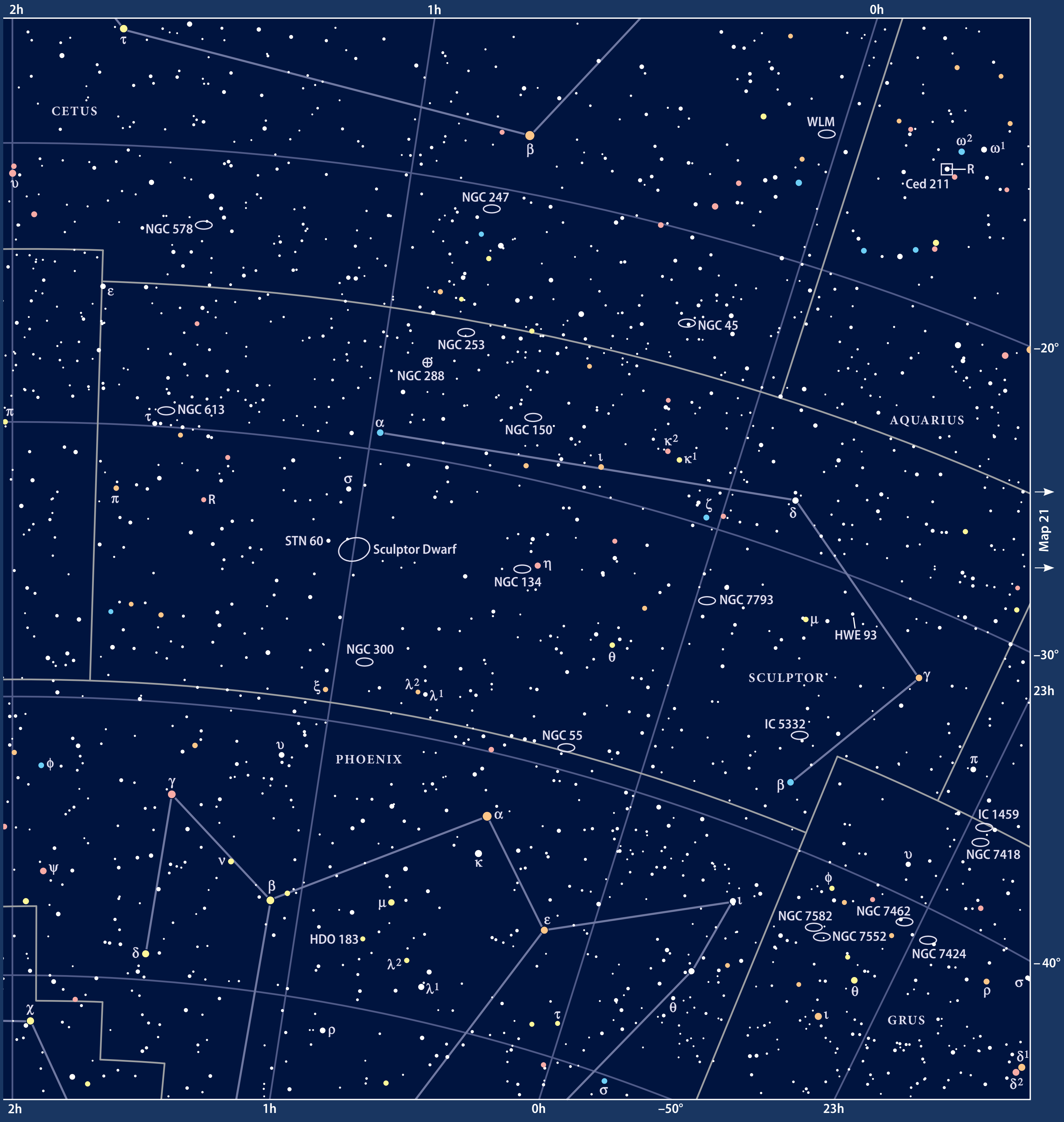
4h
3h
Map 10
2
NGC 1535
NGC 1421
ERIDANUS
γ
τ1
NGC 1407
NGC 1300
NGC 908
τ2
NGC 1232
NGC 1332
τ4
τ5
τ3
κ
NGC 1395
γ1
τ6
ζ
NGC 1255
τ7
NGC 1201
−20°
τ9
τ8
NGC 1360
γ2
ω
ν
NGC 1398
ε
α
τ
NGC 1097
ι2
ι1
μ
Map 17
σ
ρ
β
φ
δ
Fornax Dwarf
λ2
λ1
NGC 1350
FORNAX
η3
η1
η2
υ1
NGC 1537
υ2
Fornax Cluster
NGC 1532
χ1
NGC 1326
ζ
5h
−30°
41
NGC 1365
NGC 1316
NGC 986
NGC 1679
43
B 1034
ι
θ
NGC 1291
β
γ
χ
NGC 1808
δ
NGC 1792
α
NGC 1512
NGC 1448
PRTM 1
α
κ
NGC 1493
NGC 1851
CAELUM
NGC 1433
δ
R
−40°
NGC 1527
ι
COLUMBA
IC 2000
φ
A-M 1
η
PICTOR
DORADO
HOROLOGIUM
5h
−50°
4h
3h
Map 22

SOUTH EQUATORIAL 1

View the stars and constellations on this map during early winter north of the equator and early summer in the Southern Hemisphere.



Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


2h
1h
0h
CETUS
τ
β
WLM
ω2
ω1
R
Ced 211
υ
NGC 247
NGC 578
ε
NGC 45
NGC 253
−20°
NGC 288
π
τ
NGC 613
AQUARIUS
α
NGC 150
κ2
κ1
ι
σ
π
R
ζ
δ
Map 21
STN 60
Sculptor Dwarf
η
NGC 134
NGC 7793
μ
HWE 93
NGC 300
θ
−30°
SCULPTOR
γ
ξ
λ2
λ1
23h
IC 5332
NGC 55
υ
PHOENIX
φ
β
γ
π
α
IC 1459
ν
κ
NGC 7418
ψ
β
υ
φ
ι
μ
ε
NGC 7582
NGC 7462
NGC 7552
NGC 7424
δ
HDO 183
λ2
λ1
−40°
θ
θ
ρ
σ
χ
ι
GRUS
ρ
τ
δ1
σ
δ2
2h
1h
0h
−50°
23h

◌	Open cluster	α	Alpha	η	Eta	ν	Nu	τ	Tau
⊕	Globular cluster	β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
□	Diffuse nebula	γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
⌖	Planetary nebula	δ	Delta	κ	Kappa	π	Pi	χ	Chi
⬭	Galaxy	ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
		ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega

TOM DIANA

▲ **OPEN CLUSTER M41 in Canis Major is a naked-eye sight south of the night sky's brightest star, Sirius. The cluster measures 38' across.**

South of the Dog Star

The night sky's two brightest stars — Sirius (Alpha Canis Majoris) and Canopus (Alpha Carinae) frame the northern and southern boundaries of the next star map. Between these two stars lie many superb deep-sky objects, especially galaxies and open clusters.

Most beginning observers know how to locate Sirius — draw a line down (toward the southeast) from Orion the Hunter's belt. If you continue that line for an equal distance past Sirius, you'll find yourself amid the stars of Puppis the Stern, most of which lies on Map 17.

Start 4° south of Sirius at **M41**, an open cluster you'll locate easily with unaided eyes. A 6-inch telescope reveals more than 50 stars across the ½° diameter of this magnitude 4.5 cluster.

An even brighter open cluster lies 8½° southeast of M41 — the **Tau Canis Majoris Cluster** (NGC 2362). Indeed, most of this cluster's magnitude 4.1 brightness comes from the star Tau Canis Majoris, which shines 3 magnitudes brighter than the group's next brightest member. And when you look closely at Tau, you'll see a group of 10th-magnitude stars in a 6'-wide region surrounding it.

The brightest star cluster in Puppis isn't a star cluster at all. Through a telescope, **NGC 2451** appears as an impressive array of roughly a dozen bright stars around a reddish 4th-magnitude luminary. But because these stars are moving independently, and not as a group with a common center of gravity, NGC 2451 is just a chance alignment.

You'll find a true star cluster 1½° southeast of NGC 2451. At magnitude 5.8, open cluster **NGC 2477** is visible without optical aid to most observers from a dark site. So many stars of similar brightness crowd into an area ¼° across that NGC 2477 looks a bit like a loose globular cluster. Through a 6-inch scope, the central 5'-wide area resolves into 100 stars. Double your telescope's aperture to 12 inches, and you'll double the number of stars you can count. The 4th-magnitude star SAO 198545 just south of NGC 2477 lies in the foreground.

At the upper left of Map 17 is the bright planetary nebula **NGC 2440**. This magnitude 9.4 object looks slightly oval through a small telescope. A 12-inch scope shows the faint lobes at the northeast and southwest edges, as well as a faint haze surrounding the bright disk.

Lepus the Hare is a small constellation west of Canis Major that boasts a single Messier object — globular cluster **M79**. Although it glows at magnitude 7.7, this cluster is difficult to resolve in telescopes smaller than 8 inches. A larger scope will reveal many stars in M79's outer regions, as well as a large, densely packed core.

Look on Lepus' border with Canis Major to find **NGC 2196**. This galaxy is easy to find, even at magnitude 11.1, because it's small (2.8' by 2.2') and, therefore, has a high surface brightness — well, at least the nucleus does. NGC 2196's spiral arms are faint and difficult to see because they wind closely around the nucleus.

When you're ready to observe in Columba the Dove, don't miss three standout deep-sky objects in its southwest corner: **NGC 1792**, **NGC 1808**, and **NGC 1851**. The first two objects are galaxies that have interacted in the recent past. You'll need at least a 12-inch telescope just to see faint signs of the interaction. NGC 1808 also shows high star-forming activity.

NGC 1792's shape is not quite an oval. It's twice as long as wide with tightly wrapped spiral arms you'll need a big telescope to see. Notice how uniformly the magnitude 9.9 brightness spreads over NGC 1792's area.

Lying 40' to the northeast, NGC 1808 is a near twin of NGC 1792. NGC 1808 also shines at magnitude 9.9, and its dimensions are the same. Insert a low-power eyepiece, and you'll see both galaxies at once.

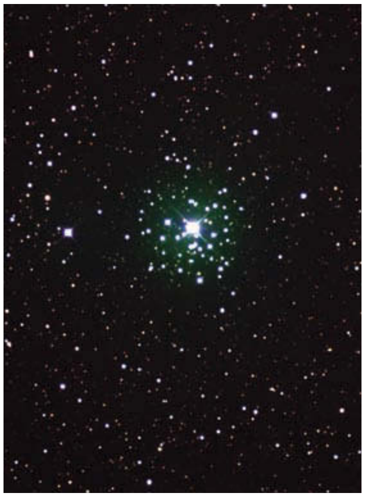
The third bright deep-sky object in this area is globular cluster NGC 1851. At magnitude 7.2, it's on the brink of naked-eye visibility. This cluster's outer stars resolve easily, but even at high magnification, the core remains too densely packed with stars to separate.

In the southwest (lower right) corner of Map 17, you can find two galaxies in the northern section of Horologium the Clock. **NGC 1512** makes an isosceles triangle with Alpha and Delta Horologii, lying roughly 2° from each. This magnitude 10.2 barred spiral galaxy has most of its brightness concentrated in its bar. A 16-inch scope reveals traces of the spiral arms, which extend from each end of the bar.

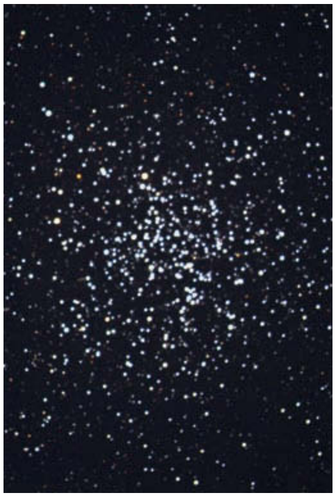
NGC 1527 lies 4½° south of NGC 1512. This magnitude 10.7 galaxy is twice as long (3') as wide. Look for two nearby stars: One shines at magnitude 12 and lies just north of the galaxy; the other glows at magnitude 13 and appears superimposed on NGC 1527's western region.

/// DOUBLE-STAR DELIGHTS — MAP 17

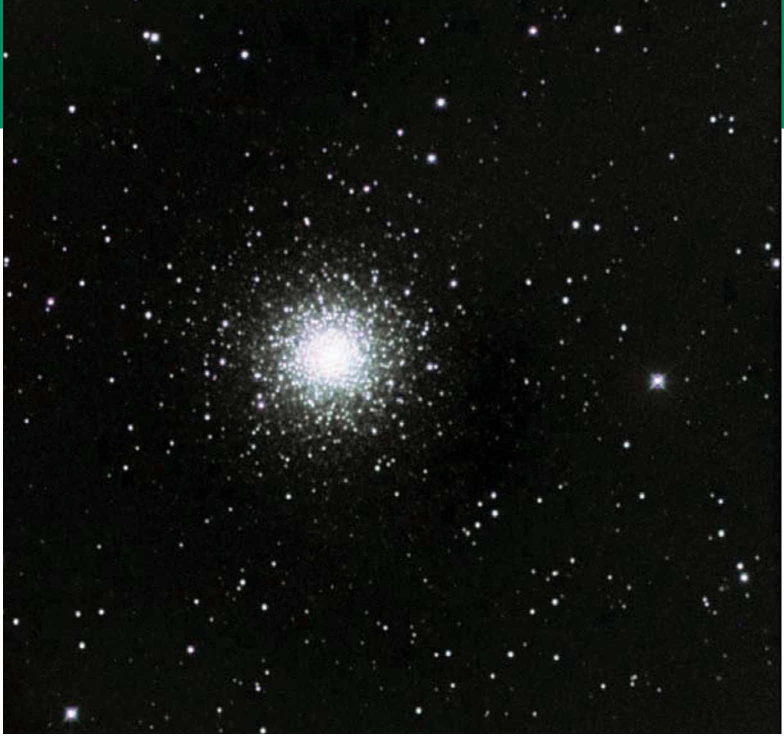
Designation	Right ascension	Declination	Magnitudes	Separation
DUN 16	3h49m	–37°37'	4.9, 5.4	8.0"
Alpha Caeli	4h41m	–41°51'	4.5, 12.5	6.6"
Gamma^1 Caeli	5h04m	–35°28'	4.7, 8.2	3.2"
DAW 117	5h21m	–34°21'	6.1, 10.9	2.2"
Alpha Columbae	5h40m	–34°04'	2.8, 12.5	13.5"
HJ 3869	6h33m	–32°01'	5.7, 7.7	24.9"
S 534	6h43m	–22°26'	6.3, 8.8	18.2"
Pi Canis Majoris	6h56m	–20°08'	4.6, 9.6	11.6"
Epsilon Canis Majoris	6h59m	–28°58'	1.6, 7.5	7.5"
HJ 3945	7h17m	–23°18'	4.8, 6.8	26.8"
Tau Canis Majoris	7h19m	–24°57'	4.4, 10.5	8.5"
Sigma Puppis	7h29m	–43°18'	3.3, 9.4	22.3"
HJ 4046	8h06m	–33°34'	6.0, 8.4	22.1"
HJ 4057	8h12m	–42°58'	4.9, 9.5	25.7"


TIM HUNTER

▲ **THE TAU CANIS MAJORIS** Cluster (NGC 2362) lies 5,000 light-years away and has a diameter of 6'. Most of the cluster's magnitude 4.1 light comes from its namesake star.


TIM HUNTER

▲ **OPEN CLUSTER** NGC 2477 in Puppis shines at magnitude 5.8, bright enough for sharp-eyed observers to spot naked-eye. NGC 2477 measures 20' across.


TIM HUNTER

▲ **GLOBULAR CLUSTER** NGC 1851 in Columba has a core too dense to resolve visually. This cluster is an easy binocular object.

TWO FOR THE PRICE OF ONE: OBSERVING DOUBLE STARS

Astronomers estimate that 60 percent of all stars throughout space are double or multiple stars. Observing double stars is fun, easy, and rewarding. It doesn't take a lot of aperture or a complicated setup; you can observe in a city, and stellar pairs exist to challenge every size telescope.

In addition to the double star's location and how bright each component is, a double-star observer needs to know two quantities. The first is the pair's apparent angular separation. This number is given in arcseconds, and it's simply the distance between the two stars.

The second quantity is the position angle. This is the angle, measured from north through east, of the fainter of the pair (the companion or secondary) from the brighter (the primary). If the companion is due north of the primary, its position angle is 0°; if it's due east, 90°; if midway between south and west, 225°.

Which double stars you can split depends on the size of your telescope because the resolution of a telescope depends only on its size. A rule of thumb for double-star observers is Dawes' Limit:

$$r = 4.56/D$$

where *r* is the separation (in arcseconds) of the closest resolvable double star, *D* is the diameter of the objective (in inches), or

$$r = 114/D$$

where *D* is the diameter of the objective (in millimeters).

Seeing double stars with close separations requires two things: high magnification and great atmospheric conditions. Resolving double stars of similar magnitudes is straightforward. It's more difficult when the companion differs from the primary by several magnitudes. In some cases, you'll find a brightness difference of up to 10 magnitudes in a double-star system (as with Sirius [Alpha Canis Majoris] A and B).

Colorful double stars

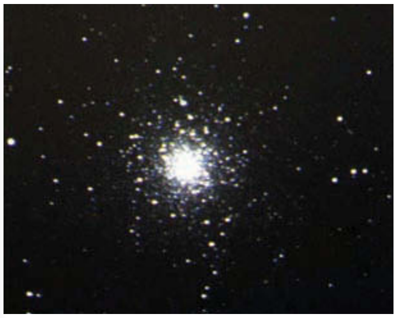
Most observers find colorful double stars a joy to behold. It takes some time to train your eye to see colors through a telescope, but the payoff is big. The closeness of double stars often helps in color identification. The contrast between two or more stars in close proximity brings out subtle color tones normally lost if you view each star separately.

Most amateur astronomers agree the best double stars to observe (and certainly the best to show to the public at star parties) are those with contrasting colors. Who among us can look at Albireo (Beta Cygni) and not be amazed? The contrast between stars colored gold and sapphire never fails to delight.

Amateur astronomers mainly see shades of red, orange, yellow, white, and blue. Green is less common, as is gray. Be certain to note in your observing log any colors you see. If you choose to sketch the pair, add the colors later. Sketching tip: Trying to distinguish colors while using a faint red flashlight is difficult.

Some of the enjoyment in amateur astronomy comes when you share your observations with others. You'll find, however, that color perception at the eyepiece is as personal and subjective as any part of amateur astronomy.

Colors you see apply to *your* eyes, period. Once, while looking through a telescope at an observing session, a friend mentioned he saw double star 107 Aquarii as white and light green. Another friend immediately stepped to the eyepiece and, after a moment, asked, "Which star are you calling green, the orange one?"

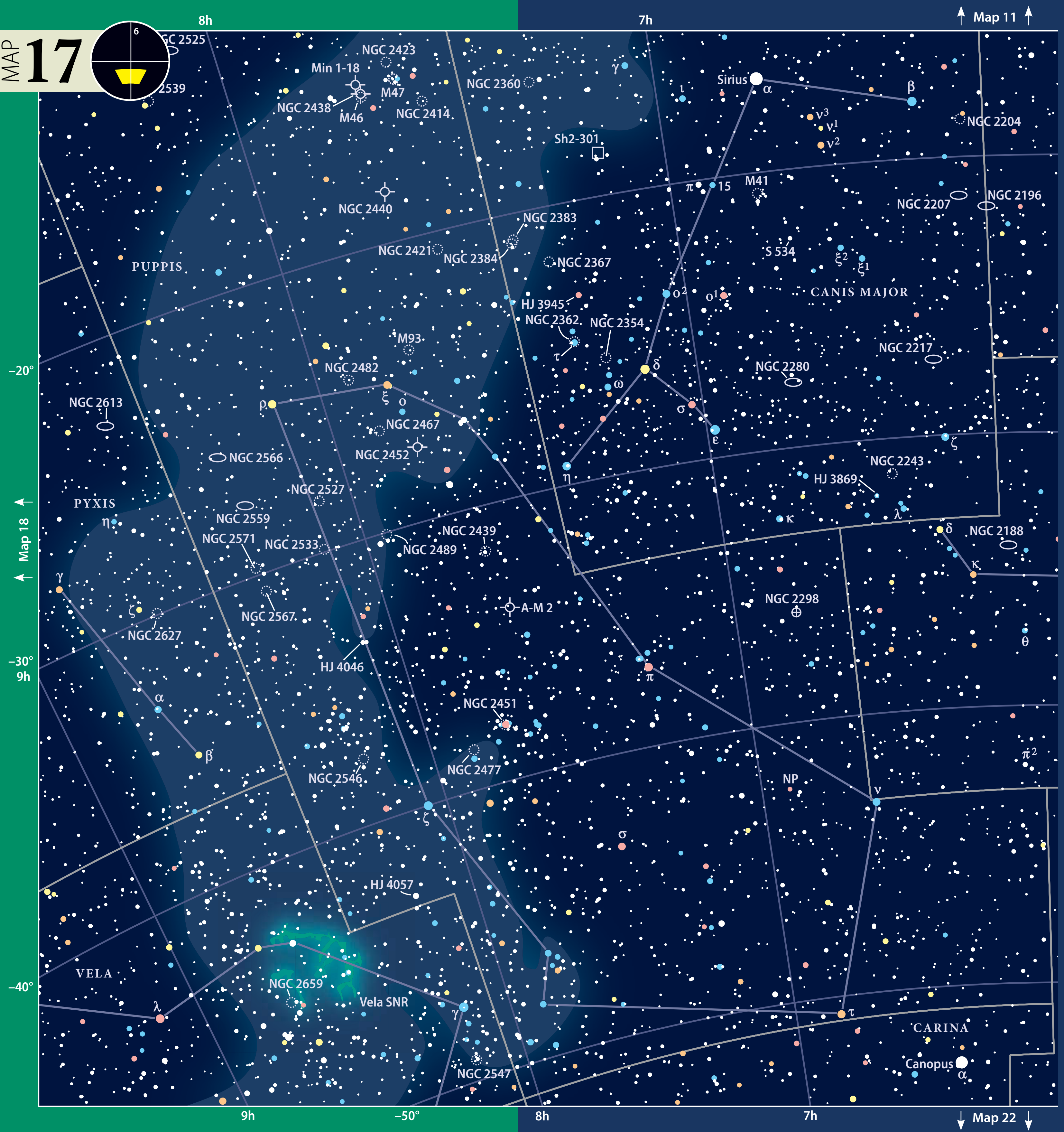

TIM HUNTER

▲ **GLOBULAR CLUSTER** M79 in Lepus the Hare shines at magnitude 7.7 from a distance of 42,000 light-years.

EYEPIECE ROAD MAP

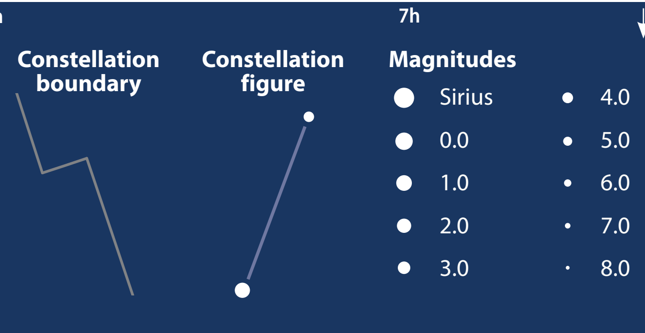
To determine the directions in your eyepiece's field of view, let the stars drift through for a while. If your telescope has a motor drive, turn it off for this check. The stars will enter the field of view from the east and exit to the west.

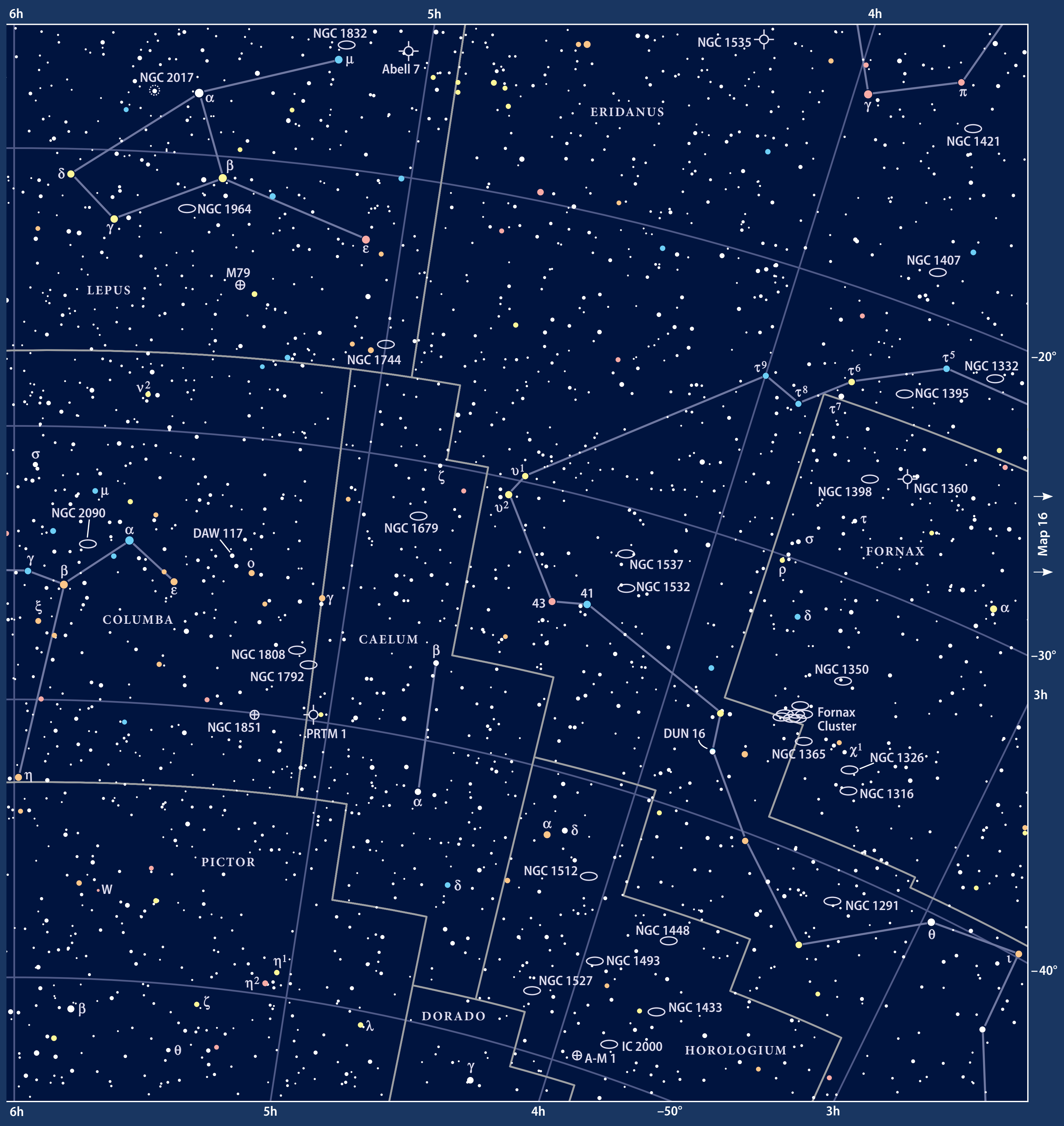
Determine the longest path for the stars you see drifting through the field. This is your east-west line; the north-south line is perpendicular to it. To find the north-south line, center a reasonably bright star, and move the telescope by hand so the objective moves toward Polaris (north). As you look through the eyepiece, the star will head south. In the Southern Hemisphere, move your scope to the south.


8h
7h
Map 11
NGC 2525
NGC 2539
NGC 2423
Min 1-18
M47
NGC 2438
M46
NGC 2414
NGC 2360
γ
Sirius
α
ι
β
ν3
ν1
ν2
NGC 2204
Sh2-301
π
15
M41
NGC 2207
NGC 2196
NGC 2440
NGC 2383
NGC 2421
NGC 2384
NGC 2367
S 534
ξ2
ξ1
PUPPIS
HJ 3945
ο2
ο1
CANIS MAJOR
NGC 2362
NGC 2354
τ
M93
NGC 2217
NGC 2482
δ
NGC 2280
–20°
ω
NGC 2613
ρ
ξ
ο
σ
NGC 2467
ε
NGC 2452
NGC 2566
η
NGC 2243
ζ
HJ 3869
NGC 2527
PYXIS
Map 18
NGC 2559
κ
λ
η
NGC 2439
δ
NGC 2188
NGC 2571
NGC 2533
NGC 2489
κ
γ
NGC 2298
ζ
NGC 2567
A-M 2
NGC 2627
θ
–30°
9h
HJ 4046
π
α
NGC 2451
β
π2
NGC 2546
NGC 2477
NP
ν
ζ
σ
HJ 4057
VELA
NGC 2659
Vela SNR
–40°
λ
γ
τ
CARINA
Canopus
α
NGC 2547
9h
–50°
8h
7h
Map 22

SOUTH EQUATORIAL 2

Use this map to locate constellations and deep-sky objects in mid-winter in the Northern Hemisphere and mid-summer south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0

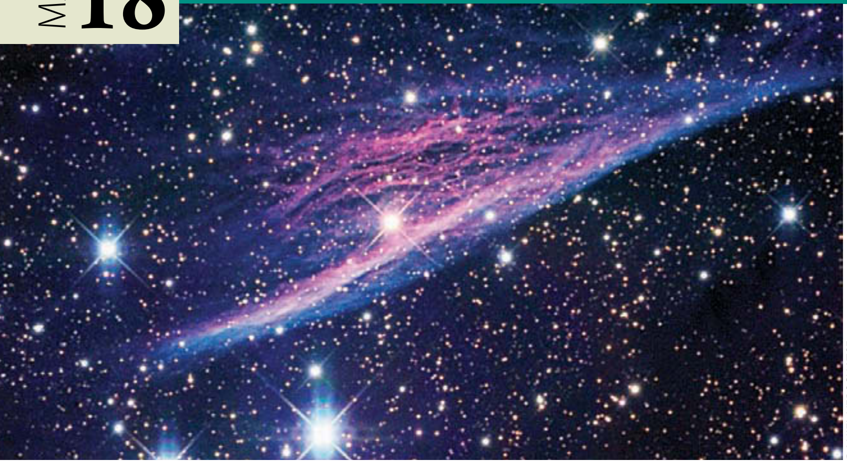


6h
5h
4h
3h
−20°
−30°
−40°
−50°
Map 16
LEPUS
ERIDANUS
COLUMBA
CAELUM
FORNAX
PICTOR
DORADO
HOROLOGIUM
NGC 1832
Abell 7
NGC 1535
NGC 2017
NGC 1421
NGC 1964
M79
NGC 1407
NGC 1744
NGC 1332
NGC 1395
NGC 1398
NGC 1360
NGC 2090
NGC 1679
DAW 117
NGC 1537
NGC 1532
43
41
NGC 1808
NGC 1792
NGC 1350
Fornax Cluster
NGC 1851
PRTM 1
DUN 16
NGC 1365
NGC 1326
NGC 1316
NGC 1512
NGC 1291
NGC 1448
NGC 1493
NGC 1527
NGC 1433
IC 2000
A-M 1
W
α
β
γ
δ
ε
ζ
η
η^1
η^2
θ
ι
λ
μ
ν²
ξ
ο
π
ρ
σ
τ
τ^5
τ^6
τ^7
τ^8
τ^9
υ^1
υ^2
χ^1

- ◌ Open cluster
- ⊕ Globular cluster
- □ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha
β	Beta
γ	Gamma
δ	Delta
ε	Epsilon
ζ	Zeta
η	Eta
θ	Theta
ι	Iota
κ	Kappa
λ	Lambda
μ	Mu
ν	Nu
ξ	Xi
ο	Omicron
π	Pi
ρ	Rho
σ	Sigma
τ	Tau
υ	Upsilon
ϕ	Phi
χ	Chi
ψ	Psi
ω	Omega

MAP 18 SOUTH EQUATORIAL 3



DANIEL VERSCHATSE

▲ **THE PENCIL NEBULA (NGC 2736) makes up the east-southeast part of the Vela Supernova Remnant, which originated about 11,000 years ago.**

Spring's Water Snake

The southern portion of Hydra — the sky's largest constellation — dominates the top part of the next star map. Because it is so large, Hydra boasts a variety of celestial gems.

Take a break from observing traditional deep-sky objects to spot **V Hydrae**, a single star many observers rate as the reddest in the sky. V Hydrae is a variable star with a period (from one peak brightness to the next) of 531 days. If it's at its maximum magnitude of 6.6, you may be able to spot it with unaided eyes from a dark site. At minimum, the star's brightness drops to magnitude 9.0. Its color, however, gives it away. Use a telescope, and slightly defocus the image to see V Hydrae at its reddest.

A bright galaxy in Hydra, **NGC 3621**, shines at magnitude 8.9. Twice as long as it is wide (9.8' by 4.6'), NGC 3621 has a bright nucleus that covers only 15". NGC 3621 is a spiral galaxy, but you'll need a 14-inch or larger scope to see any of its structure.

Not many planetary nebulae shine as brightly as magnitude 7.8, so when you have a chance to observe one, don't miss it. Such an object, the **Ghost of Jupiter** (NGC 3242), lies 2° south of Mu Hydrae. Objects like the Ghost of Jupiter inspired English astronomer John Herschel to coin the term "planetary nebulae." NGC 3242 measures 13" across, which is about the same as Mars at a distant opposition (the point in its orbit when it lies opposite the Sun in our sky). At low magnification, the Ghost's color — blue-green — resembles Uranus'. Once you've verified this, crank up the power in steps. You'll see a faint shell 40" across surrounding a brighter, football-shaped interior. An even closer look reveals an empty space 10" across that contains the planetary's central star.

The constellation due south of the Ghost of Jupiter is Antlia the Air Pump. Small and sparse, Antlia contains only four stars brighter than 5th magnitude. Another slightly fainter star you'll spot easily from a dark site is **U Antliae**. This star is similar in color to V Hydrae, described above, only brighter. Such objects are known as carbon stars, and they're all intensely red. For a list of the sky's reddest stars, see page 97.

Magnitude 9.3 **NGC 2997** is one of only two galaxies in Antlia that show any detail through medium-sized telescopes. Through a 10-inch scope, you'll see an indistinct glow 5' by 3' aligned east-west. The other galaxy is **NGC 3175**, a nearly edge-on spiral 3 times as long as it is wide. With a length of 3' and a magnitude of only 11.3, NGC 3175 appears faint.

/// DOUBLE-STAR DELIGHTS — MAP 18

Designation	Right ascension	Declination	Magnitudes	Separation
DUN 70	8h30m	–44°43'	5.2, 6.8	4.5"
Eta Pyxidis	8h38m	–26°15'	5.2, 13.0	16.0"
Beta Pyxidis	8h40m	–35°18'	4.0, 12.5	12.7"
COO 74	8h40m	–40°15'	5.2, 8.5	4.0"
Epsilon Pyxidis	9h10m	–30°21'	5.6, 9.9	17.7"
Zeta^1 Antliae	9h31m	–31°53'	6.3, 7.2	8.0"
HJ 4218	9h33m	–36°24'	7.6, 10.5	5.7"
SHJ 110	10h04m	–18°06'	5.8, 8.0	21.2"
Delta Antliae	10h30m	–30°36'	5.7, 9.7	11.0"
Struve 1474	10h48m	–15°14'	7.5, 7.8	6.8"
BSO 6	11h29m	–42°40'	5.4, 8.1	13.0"
HJ 4455	11h37m	–33°34'	6.0, 8.1	3.3"
HJ 4518	12h25m	–41°23'	6.2, 9.5	10.0"

It's worth stopping in Pyxis to view two open star clusters. The first is magnitude 8.4 **NGC 2627**. If you use an 8-inch scope at 50x, you'll see 40 stars in a region 6' across and many more hinted at in the background.

Now move to **NGC 2818**. At magnitude 8.2, it's a bit brighter than NGC 2627, but it's special for a different reason: NGC 2818 contains a planetary nebula. The nebula looks like a small version of the Dumbbell Nebula (M27) in Vulpecula. You'll see 30 stars in an area about 9' across.

Vela is a large constellation with few bright stars. In the 18th century, the constellation Vela did not exist. Its stars were part of a larger constellation named Argo Navis, which, according to Greek mythology, was the ship Jason and the Argonauts used to find the Golden Fleece. The constellation Argo Navis was so unwieldy that later astronomers subdivided it into Carina the Keel, Puppis the Deck, and Vela the Sails.

The **Vela Supernova Remnant** is the sky's largest supernova remnant, covering 5°. The best way to observe this object is to use a 12-inch or larger telescope with a low-power eyepiece and a nebula filter, such as an OIII. Either disengage the drive motor, or set your slewing speed at "medium," and scan the area. Only one portion of this region has an NGC number assigned to it. The east-southeast region carries the designation **NGC 2736**, and observers most often call it the Pencil Nebula.

Look 2° south of Gamma Velorum for **NGC 2547**. At magnitude 4.7, it's an easy naked-eye object. NGC 2547 measures 1° across, but through a 6-inch or larger scope, you'll see nearly all of its stars in a ½° area. And, yes, the magnitude 6.5 star is part of the cluster, not a foreground star.

Get out your binoculars (and Map 23) and look 2° north-northwest of Delta Velorum for **IC 2391**, a magnitude 2.5 open cluster almost 1° across. Binoculars highlight this object's brightest stars, but a telescope with a wide-angle eyepiece will let you go a bit deeper. In all, expect to see about 30 stars brighter than 12th magnitude.

The **Eight-Burst Nebula** (NGC 3132) lies in Vela's northeast corner. This is a magnitude 9.7 planetary nebula comprising a 10th-magnitude central star surrounded by a shell measuring 60" by 45". The shell's outer regions are brightest, but a 10-inch or larger telescope will allow you to see this object's splotchy interior.

CLOUDS OF COLOR: OBSERVING NEBULAE

The word *nebula* is Latin for "cloud." A nebula is a cloud of gas and dust in space. Several types of nebulae exist: bright, dark, and planetary.

Bright nebulae

Bright (or diffuse) nebulae are frequently places of star formation. When stars begin to form, some are hot enough that their radiation excites the nebula's gas, ionizing it and causing it to shine. This is an *emission nebula*. If the stars aren't hot enough to cause ionization, the nebula's dust scatters and reflects their light, creating a *reflection nebula*.

The Orion Nebula (M42), discovered in 1610, was the first bright nebula ever observed. M78, also in Orion, became the first reflection nebula discovered when Pierre Méchain spotted it in 1780. Other emission nebulae in Messier's catalog are the Lagoon Nebula (M8), the Eagle Nebula (M16), the Swan Nebula (M17), the Trifid Nebula (M20), and M43. M16 is actually a double object, a star cluster (NGC 6611) and a famous nebula known as the Eagle Nebula (IC 4703).

Dark nebulae

Dark nebulae are clouds of dust and gas. We see them only because they obscure light from stars or bright nebulae behind them. Some dark nebulae, for example, the Horsehead Nebula (B33) in Orion, are small and difficult to see even through large telescopes. Others, such as the Coal Sack in Crux, are large and easy to see with your unaided eyes.

The darkness of these objects is due to dust grains and cold hydrogen molecules within the clouds. Very cold. The internal temperature is about –442° Fahrenheit. The largest of the dark nebulae, called molecular clouds, are huge areas of future star formation.

Planetary nebulae

A planetary nebula is the most common end product of stellar evolution. Stars as massive or slightly more massive than the Sun eject their exterior layers near the end of their lives. The ejected envelope becomes a planetary nebula — a spherical shell of thin matter expanding into space at more than 20,000 mph.

The central star reaches 350,000° F and emits lots of ultraviolet radiation, which ionizes the gas of the expanding planetary nebula and causes the gas to glow. As the shell expands, the star excites the gas, but only out to a certain distance. So, after 10,000 to 50,000 years, the planetary nebula stops glowing. It continues expanding, but we can't see it.

DANIEL VERSCHATSE

▲ **THE EIGHT-BURST NEBULA (NGC 3132) in Vela is a planetary nebula.**

Roughly 1,000 planetary nebulae exist in our neighborhood of the galaxy. A typical planetary nebula measures less than 1 light-year across.

What color is a typical planetary nebula? This is tricky to answer. The dominant color is close to the border between the eye's perceived green and perceived blue colors. So, even a slight shift in an observer's perceived color response could cause the nebula's color to appear either greenish or bluish.

A planetary nebula's altitude in the sky also affects its perceived color, although not to a large extent. Atmospheric reddening means any planetary viewed at a higher altitude will be slightly bluer than when it's seen nearer to the horizon.

How to observe nebulae

Use the biggest telescope you can when observing bright and planetary nebulae. A large scope may gather enough of the object's light to allow you to see color. Filters labeled "nebula," "LPR," "UHC," and "OIII" also help by increasing contrast.

When you observe a bright nebula, move your scope slightly to see the entire object. If you can see stars, determine which are involved with the nebula.

More than half of all planetaries are stellar (starlike) in appearance. For beginning amateur astronomers, they're not much fun to observe. Most other planetaries have diameters less than 1'. Examples of large planetaries are the Dumbbell Nebula (M27) and the Owl Nebula (M97). Many fine planetary nebulae have apparent diameters between 15" and 1'. Examples include the Blue Snowball (NGC 7662) and the Ghost of Jupiter (NGC 3242). Planetary nebulae are visible best through an OIII filter.

/// OBSERVE THESE BRIGHT NEBULAE

Designation	R.A.	Dec.	Size	Map
NGC 281	0h53m	56°36'	35' by 30'	1
NGC 1499	4h01m	36°38'	160' by 40'	5
NGC 1931	5h31m	34°12'	4' by 4'	5
M1	5h35m	22°02'	8' by 2'	5
M42	5h35m	–5°28'	90' by 60'	11
NGC 1999	5h36m	–6°44'	2' by 2'	11
IC 434	5h42m	–2°27'	90' by 30'	11
NGC 2170	6h07m	–6°23'	2' by 2'	11
NGC 2175	6h10m	20°29'	40' by 30'	5
NGC 2264	6h41m	9°54'	10' by 7'	11
M20	18h02m	–23°00'	20' by 20'	20
M8	18h04m	–24°20'	45' by 30'	20
NGC 6559	18h10m	–23°59'	15' by 10'	20
NGC 6590	18h17m	–19°44'	4' by 3'	20
M16	18h19m	–13°49'	120' by 25'	14
M17	18h21m	–15°59'	40' by 30'	14
NGC 6888	20h13m	38°19'	20' by 10'	9
NGC 6914	20h25m	42°23'	3' by 3'	9

R.A. = Right ascension; Dec. = Declination

/// GREAT BARNARD CATALOG OBJECTS

Designation	R.A.	Dec.	Size	Map
B33, Horsehead Nebula	5h41m	–2°30'	6' by 4'	11
B42, Rho Ophiuchi	16h29m	–24°18'	12' by 12'	20
B65/6/7, Pipe Nebula (stem)	17h21m	–26°48'	300' by 60'	20
B72, Snake Nebula	17h24m	–23°36'	30' by 30'	20
B78, Pipe Nebula (bowl)	17h33m	–25°42'	200' by 140'	20
B86, Ink Spot Nebula	18h03m	–27°47'	5' by 3'	20
B87, Parrot's Head Nebula	18h04m	–32°40'	12' by 12'	20
B142/3, Barnard's E	19h41m	11°00'	110' by 80'	14
B348/9, Cygnus Rift	20h37m	42°13'	240' by 240'	8

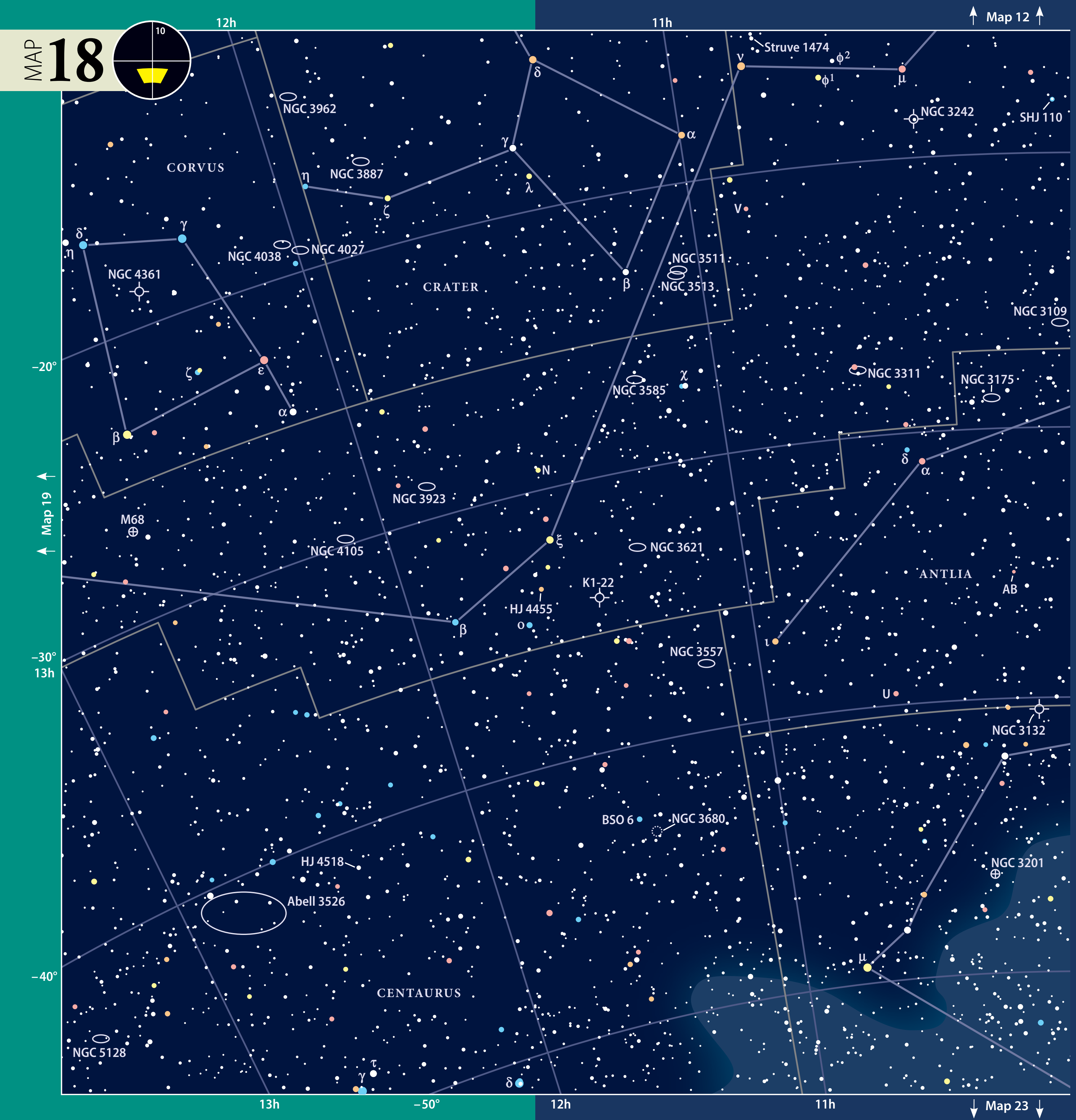
R.A. = Right ascension; Dec. = Declination

/// THE DARKEST DARK NEBULAE

Designation	R.A.	Dec.	Area	Map
LDN 1506	4h20m	25°17'	0.334	5
LDN 1535	4h36m	23°54'	0.111	5
LDN 1544	5h04m	25°14'	0.109	5
LDN 1622	5h55m	2°00'	0.122	11
LDN 1709	16h33m	–23°46'	0.099	20
LDN 204	16h48m	–12°05'	0.167	14
LDN 162	16h49m	–14°15'	0.124	14
LDN 65	17h13m	–21°54'	0.088	20
LDN 513	18h11m	–1°33'	0.127	14
LDN 557	18h39m	–1°47'	0.181	14
LDN 530	18h50m	–4°47'	1.124	14
LDN 673	19h21m	11°16'	0.199	14
LDN 694	19h41m	10°57'	0.109	14

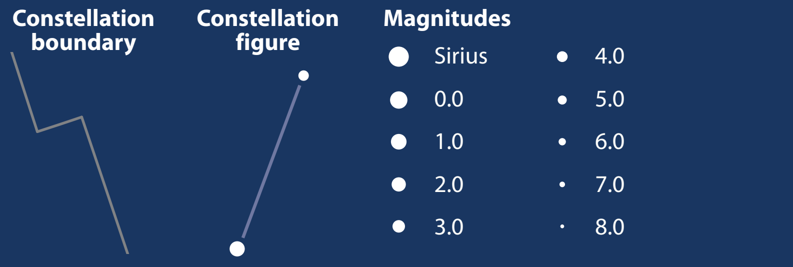
LDN = Lynd's Dark Nebula; R.A. = Right ascension; Dec. = Declination; Area given in square degrees

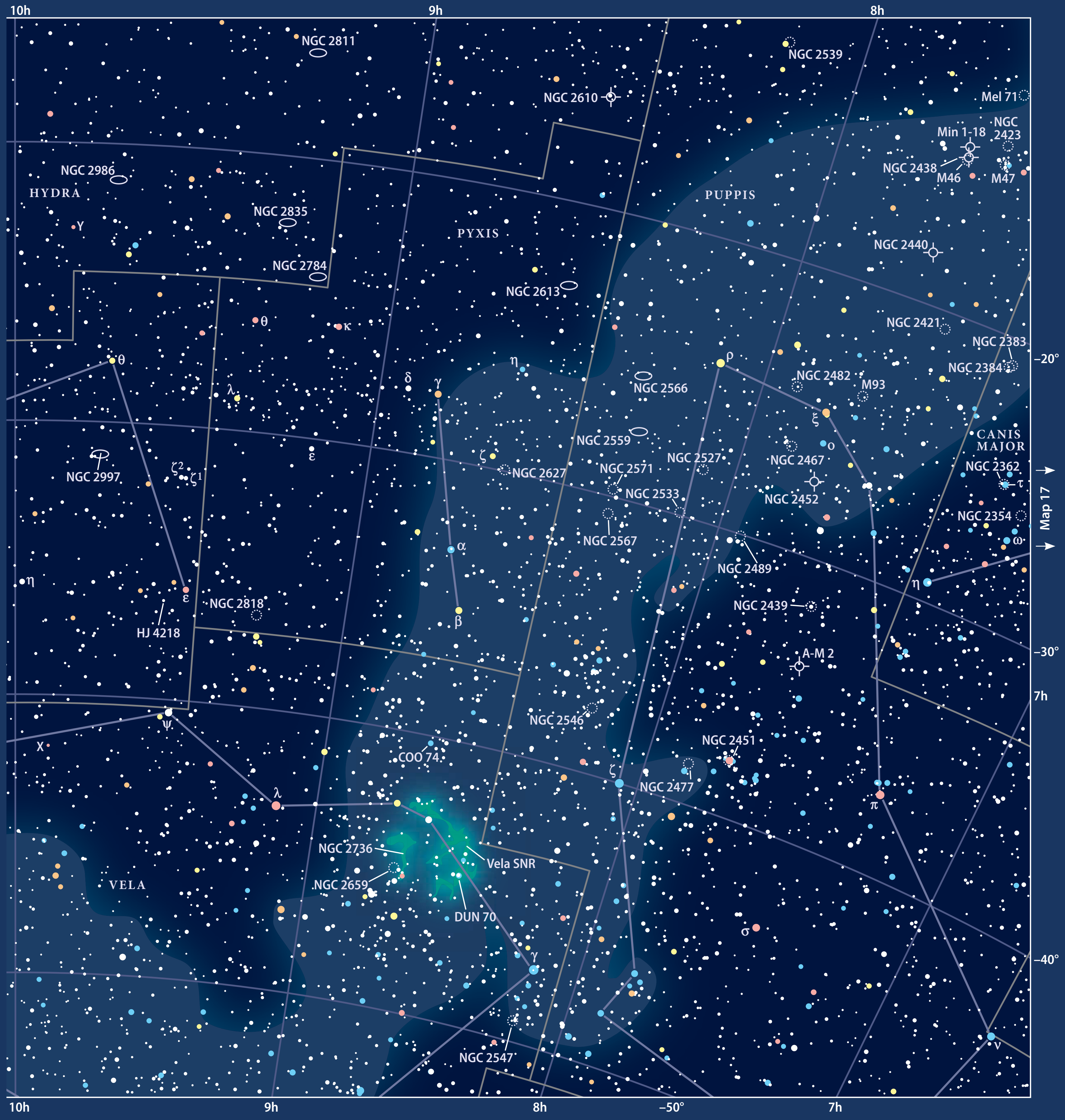
MAP 18


10
12h
11h
Map 12
Struve 1474
ϕ2
ϕ1
ν
μ
NGC 3242
SHJ 110
NGC 3962
δ
α
γ
CORVUS
NGC 3887
η
ζ
λ
V
δ
γ
η
NGC 4038
NGC 4027
NGC 4361
CRATER
β
NGC 3511
NGC 3513
NGC 3109
–20°
ζ
ε
α
β
NGC 3585
χ
NGC 3311
NGC 3175
δ
α
N
NGC 3923
Map 19
M68
NGC 4105
ξ
NGC 3621
ANTLIA
AB
K1-22
HJ 4455
β
o
NGC 3557
ι
–30°
13h
U
NGC 3132
BSO 6
NGC 3680
NGC 3201
HJ 4518
Abell 3526
μ
–40°
CENTAURUS
NGC 5128
τ
γ
δ
13h
–50°
12h
11h
Map 23

SOUTH EQUATORIAL 3

View the stars and deep-sky objects on this map during early spring in the Northern Hemisphere and early autumn south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


10h
9h
8h
NGC 2811
NGC 2539
NGC 2610
Mel 71
Min 1-18
NGC 2423
NGC 2438
M46
M47
NGC 2986
HYDRA
PUPPIS
PYXIS
NGC 2835
NGC 2440
NGC 2784
NGC 2613
NGC 2421
NGC 2383
NGC 2384
–20°
NGC 2566
NGC 2482
M93
NGC 2559
NGC 2467
CANIS MAJOR
NGC 2997
NGC 2627
NGC 2571
NGC 2527
NGC 2362
NGC 2533
NGC 2452
NGC 2354
Map 17
NGC 2567
NGC 2489
NGC 2818
NGC 2439
HJ 4218
A-M 2
–30°
7h
NGC 2546
NGC 2451
COO 74
NGC 2477
VELA
NGC 2736
Vela SNR
NGC 2659
DUN 70
–40°
NGC 2547
10h
9h
8h
–50°
7h
α
β
γ
δ
ε
ζ
ζ1
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ν
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χ
ω

- ◌ Open cluster
- ⊕ Globular cluster
- ☐ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega

MAP 19 SOUTH EQUATORIAL 4

DANIEL VERSCHATSE

▲ **GLOBULAR CLUSTER** **M68 in Hydra lies 33,000 light-years from Earth. This object measures 11' across and shines at magnitude 7.6.**

Wolf and Centaur

Two large, bright constellations — Lupus the Wolf and Centaurus the Centaur — dominate the next star map. The majority of each constellation lies along the Milky Way's border, so a variety of deep-sky objects awaits your inspection. Hydra's faint eastern half also appears.

Start 2.9° east-northeast of magnitude 3.4 Zeta Lupi with **NGC 5927**, a magnitude 8.0 globular cluster that's 12' across. You may need a telescope as large as 16 inches to resolve this cluster's myriad faint stars.

Globular cluster **NGC 5986** — at magnitude 7.5 — is a bit brighter than NGC 5927, and its stars resolve more easily. A 6-inch scope shows a few stars. Move up to a 12-inch under a dark sky, crank the magnification up to 200x, and dozens more stars will pop into view. NGC 5986 makes a small triangle with a 6th- and 7th-magnitude star ¼° to the east.

Two planetary nebulae — **IC 4406** and **NGC 5882** — deserve some of your observing time. IC 4406 glows at magnitude 10.2 and is roughly 1.5' across. An 8-inch or larger telescope reveals a rectangular object much brighter at its center with fainter extensions stretching east and west.

NGC 5882 shines at magnitude 9.4 and stretches 18" in diameter. It's circular and glows a vivid blue-green through an 8-inch or larger scope.

A visual survey of Centaurus reveals a fuzzy star — Omega — that happens to be the sky's brightest globular cluster, **NGC 5139**. Gleaming at magnitude 3.5, this object was misidentified by German stellar mapmaker Johannes Bayer. In his 1603 work, *Uranometria* — the first star maps to use Greek letters to identify the stars — Bayer assigned this globular the Greek letter Omega, a designation it has retained ever since.

Omega Centauri is a wonder to behold through binoculars or telescopes of any size. Omega appears slightly larger than the Full Moon, and, because it's rotating relatively quickly, its shape is slightly out-of-round. Through an 8-inch telescope, you'll see 1,000 stars, each a faint pinprick of light. At high power, the stars appear nearly uniformly distributed across the field of view.

Move 4.5° north of NGC 5139 to find irregular galaxy **Centaurus A** (NGC 5128). Although this object shines at magnitude 6.7, you won't see it with unaided eyes even from the darkest site because its light spreads over an area that measures 31' by 23'. Through a 12-inch telescope, you'll see the central circular haze 8' across divided by a dark lane 1' wide. A 12th-magnitude star lies in front of the dust lane at the northwest end.

Only 17' from Iota Centauri sits spiral galaxy **NGC 5102**, which measures 10' by 4' and shines at magnitude 8.8. Most of NGC 5102's brightness comes from its core. Be sure Iota Cen lies outside the field of view when you observe this galaxy, or the glare will overwhelm the view.

DANIEL VERSCHATSE

▲ **BARRED SPIRAL GALAXY** **M83 appears face-on, an alignment that makes this magnitude 7.5 galaxy a showpiece.**

DOUBLE-STAR DELIGHTS — MAP 19

Designation	Right ascension	Declination	Magnitudes	Separation
JC 17	12h10m	–34°42'	6.3, 8.1	3.4"
Xi^2 Centauri	13h07m	–49°54'	4.4, 9.5	25.1"
HWE 94	13h49m	–35°41'	6.6, 9.6	11.6"
RMK 18	13h52m	–52°48'	5.7, 7.9	18.1"
4 Centauri	13h53m	–31°55'	4.8, 8.5	14.9"
54 Hydrae	14h46m	–25°26'	5.2, 7.2	8.4"
Kappa Centauri	14h59m	–42°06'	3.4, 11.5	3.9"
HJ 4727	15h04m	–27°50'	8.6, 8.7	7.6"
Kappa^1 Lupi	15h12m	–48°44'	4.1, 6.0	26.6"
Upsilon Librae	15h37m	–28°07'	3.8, 10.8	3.3"
Omega Lupi	15h38m	–42°33'	4.3, 11.0	11.8"
Xi^1 Lupi	15h57m	–33°57'	5.3, 5.8	10.4"
Eta Lupi	16h00m	–38°24'	3.6, 7.8	15.0"

For something a bit different, look 2° north of Phi Centauri. This object is the bright reflection nebula **NGC 5367**. Through a 12-inch telescope, you'll see an evenly illuminated haze roughly 2' across. To the northeast is a detached region that measures 2' by 1'.

Now, move to the eastern part of Hydra, which also lies on this star map. Hydra's brightest galaxy, and a showpiece of the "near-southern" sky, is **M83** (NGC 5236). M83 is a barred spiral galaxy that appears nearly face-on. This fortuitous alignment lets us observe its spiral arms through telescopes as small as 6 inches in diameter. M83's bar is aligned northeast-to-southwest. The galaxy's core is brilliant and unresolvable. Through a 12-inch or larger scope, look for dark lanes of dust and cold gas within the spiral arms. M83 shines at magnitude 7.5 and measures 15' long.

Another Messier object in southern Hydra is globular cluster **M68** (NGC 4590). At magnitude 7.6, this object glows slightly fainter than M83. The star cluster looks brighter, however, because its light spreads over an area only 12' across. Although it's bright, M68 doesn't resolve well. Even through a 12-inch scope, you'll see fewer than 30 individual stars in front of the cluster's nucleus.

BEACONS IN THE DARK: OBSERVING STAR CLUSTERS

A star cluster is a group of stars held together by gravity. The two main types of star clusters are open clusters and globular clusters.

Open clusters

Open clusters (also known as *galactic clusters*) lie within our galaxy's disk. We've known a few of the brightest for thousands of years. The Beehive (M44) in Cancer the Crab as well as the Pleiades (M45) and the Hyades, both in Taurus the Bull, have numerous historical references. Greek philosopher Ptolemy (85–165) mentioned Melotte 111 in Coma Berenices and M7 in Scorpius. Not until Galileo (1564–1642) trained his telescope on the Beehive, however, did we learn these objects are collections of stars.

Sparse open clusters contain less than 100 stars, while rich ones may have thousands. Open clusters form from nebulae (see "Clouds of color" on page 73). All open clusters are young objects, generally no more than a few hundred million years old. Few older open clusters exist because, given enough time, the stars in an open cluster disperse as they interact gravitationally with other cluster stars. M67 in Cancer is an exception. If we could follow an open cluster from its formation, we'd see stars being expelled during its entire galactic journey.

Stars in open clusters are rich in heavy elements (an astronomer's way of saying any elements other than hydrogen or helium). Astronomers have cataloged approximately 1,700 open clusters.

Compared to other deep-sky objects, open clusters are large. This means you'll generally use low-power eyepieces with wide fields of view. Some clusters are large enough and bright enough that binoculars will provide more satisfying views. You can observe hundreds of clusters through 7x50 or larger binoculars.

Some open clusters contain other celestial objects. M46 in Puppis, for example, contains a bright planetary nebula you can see through a medium-sized telescope. Other clusters have diffuse nebulae or smaller clusters within or near their boundaries. Also, double stars and interesting star patterns abound.

Take your time when observing an open cluster. Examine the field of view closely. Try to discern stars that are members of the cluster as opposed to field stars. Usually this is easy, but it can be tricky when the cluster lies against the Milky Way. Also, large scopes sometimes can hinder the identification of cluster stars; they make so many background stars visible that confusion ensues.

DANIEL VERSCHATSE

▲ **OMEGA CENTAURI (NGC 5139) outshines every other globular cluster in the sky. Through any size telescope, this object is a wonder to behold.**

Globular clusters

In the deep-sky menagerie, no group of objects excites new observers more than globular clusters. Even many seasoned amateur astronomers consider them the most rewarding objects to observe. It's easy to see why. Many are bright enough to be seen even from urban settings. But when observed from a dark site, globulars explode with detail. Use high magnification, and you'll explore a whole new level of detail: Faint fuzz resolves into individual, sparkling points of light that form intricate patterns.

When observing globular clusters, begin by concentrating on the constellations Ophiuchus, Scorpius, and Sagittarius (Maps 14 and 20). You'll discover nearly 70 globular clusters in these three constellations. That's right, more than one-third of all known Milky Way globulars are located in an area that comprises only 5.6 percent of the sky.

Globular clusters may seem just round at first glance. But carefully note the subtle shape of each. Some are slightly elliptical. Some seem to have "arms" that extend beyond the general concentration of stars. Ask yourself questions at the eyepiece: How concentrated is the cluster? What's the range of star brightnesses? How rich is the cluster? With medium-sized telescopes, you'll count dozens or even hundreds of stars that lie apart from the cluster's central condensation.

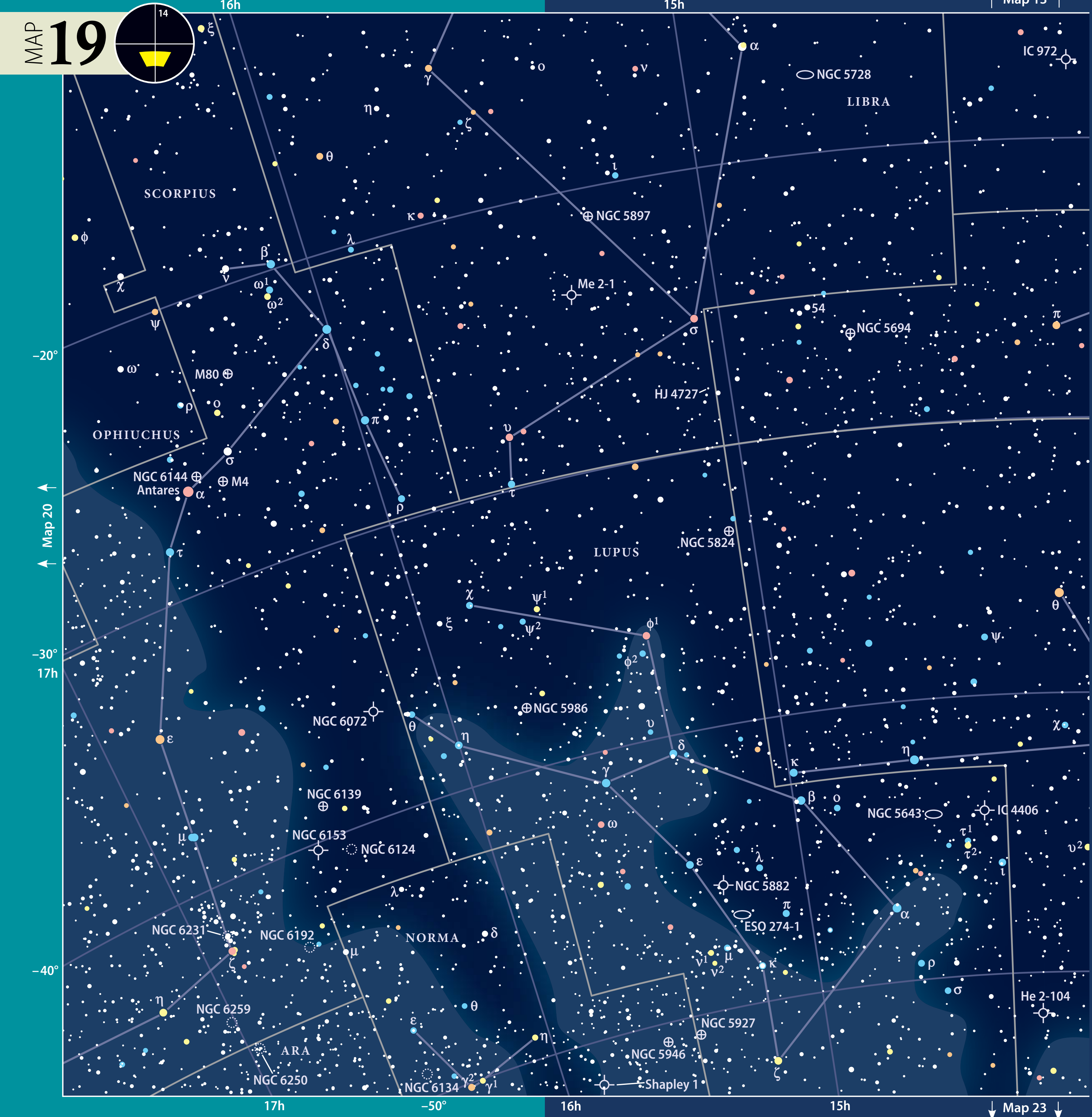
▲ **NGC 5078 in Hydra looks like a sandwich because of its dark lane. Below is its companion galaxy, IC 879.** DANIEL VERSCHATSE

/// 20 BRIGHTEST OPEN CLUSTERS

	Object	Constellation	Magnitude	Map
1	Melotte 25	Taurus	0.5	5
2	Melotte 20	Perseus	1.2	4
3	M45	Taurus	1.5	4
4	Melotte 111	Coma Berenices	1.8	7
5	IC 2602	Carina	1.9	23
6	NGC 6231	Scorpius	2.6	20
7	M44	Cancer	3.1	6
8	M7	Scorpius	3.3	20
9	NGC 2362	Canis Major	3.8	17
10	NGC 2264	Monoceros	4.0	11
11	M6	Scorpius	4.2	20
12	NGC 4755	Crux	4.2	23
13	NGC 869/884	Perseus	4.4	1
14	M47	Puppis	4.4	11
15	M41	Canis Major	4.5	17
16	NGC 1981	Orion	4.6	11
17	M25	Sagittarius	4.6	20
18	M39	Cygnus	4.6	9
19	NGC 6633	Ophiuchus	4.6	14
20	NGC 2244	Monoceros	4.8	11

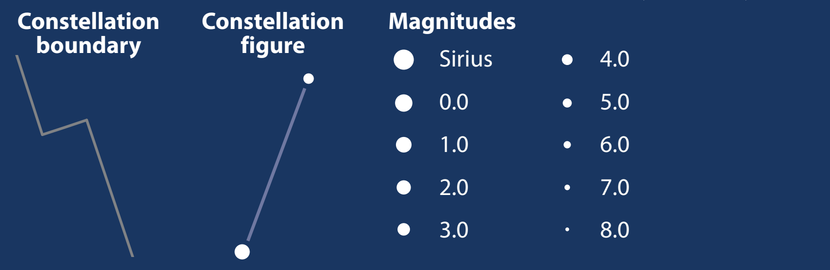
/// 20 BRIGHTEST GLOBULAR CLUSTERS

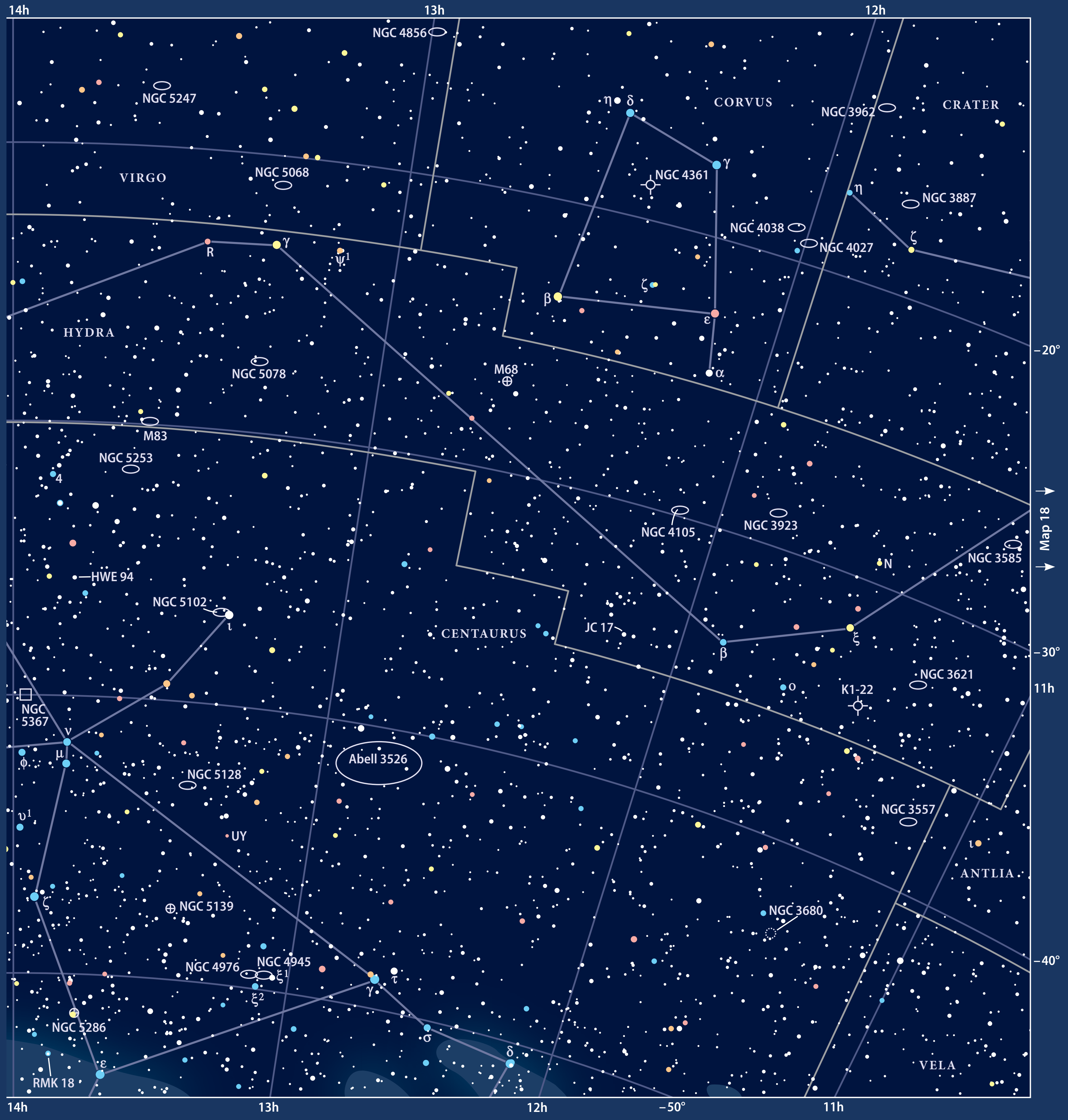
	Object	Constellation	Magnitude	Map
1	NGC 5139	Centaurus	3.5	19
2	NGC 104	Tucana	4.0	22
3	M22	Sagittarius	5.2	20
4	NGC 6397	Ara	5.3	24
5	NGC 6752	Pavo	5.3	24
6	M4	Scorpius	5.4	20
7	M5	Serpens	5.7	13
8	M13	Hercules	5.8	8
9	M12	Ophiuchus	6.1	14
10	NGC 2808	Carina	6.2	23
11	NGC 6541	Corona Australis	6.3	20
12	M3	Canes Venatici	6.3	7
13	M15	Pegasus	6.3	15
14	M55	Sagittarius	6.3	20
15	M62	Ophiuchus	6.4	20
16	M92	Hercules	6.5	8
17	M10	Ophiuchus	6.6	14
18	M2	Aquarius	6.6	15
19	NGC 362	Tucana	6.8	22
20	NGC 6723	Sagittarius	6.8	20


MAP 19
14
16h
15h
Map 13
ξ
γ
ο
ν
α
NGC 5728
IC 972
LIBRA
η
ζ
θ
ι
SCORPIUS
ϕ
κ
NGC 5897
λ
β
χ
ν
ω1
ω2
Me 2-1
54
NGC 5694
π
ψ
σ
−20°
ω
M80
ρ
ο
HJ 4727
δ
π
OPHIUCHUS
υ
σ
NGC 6144
M4
Antares
α
τ
ρ
Map 20
τ
LUPUS
NGC 5824
θ
χ
ψ1
ψ2
ξ
ϕ1
ϕ2
ψ
−30°
17h
NGC 6072
θ
NGC 5986
υ
χ
ε
η
δ
γ
κ
η
NGC 6139
β
ο
NGC 5643
IC 4406
ω
τ1
τ2
υ2
μ
NGC 6153
NGC 6124
ε
λ
ι
NGC 5882
λ
π
α
NGC 6231
NGC 6192
δ
NORMA
μ
ESO 274-1
ν1
μ
ν2
κ
ρ
−40°
ζ
η
NGC 6259
θ
σ
He 2-104
ε
NGC 5927
ARA
η
NGC 5946
NGC 6250
NGC 6134
γ2
γ1
Shapley 1
ζ
17h
−50°
16h
15h
Map 23

SOUTH EQUATORIAL 4

View the stars and constellations on this map during mid-spring north of the equator and mid-autumn in the Southern Hemisphere.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


14h
13h
12h
NGC 4856
NGC 5247
CORVUS
CRATER
VIRGO
NGC 5068
NGC 4361
NGC 3962
NGC 3887
NGC 4038
NGC 4027
HYDRA
NGC 5078
M68
M83
NGC 5253
NGC 4105
NGC 3923
NGC 3585
Map 18
HWE 94
NGC 5102
JC 17
CENTAURUS
NGC 3621
K1-22
NGC 5367
Abell 3526
NGC 5128
NGC 3557
UY
ANTLIA
NGC 5139
NGC 3680
NGC 4976
NGC 4945
NGC 5286
RMK 18
VELA
N
R
4
–20°
–30°
–40°
11h
–50°
η
δ
γ
ζ
β
ε
α
ψ¹
ι
ν
μ
φ
υ¹
ξ
ο
τ
σ
ξ¹
ξ²

◌ Open cluster

⊕ Globular cluster

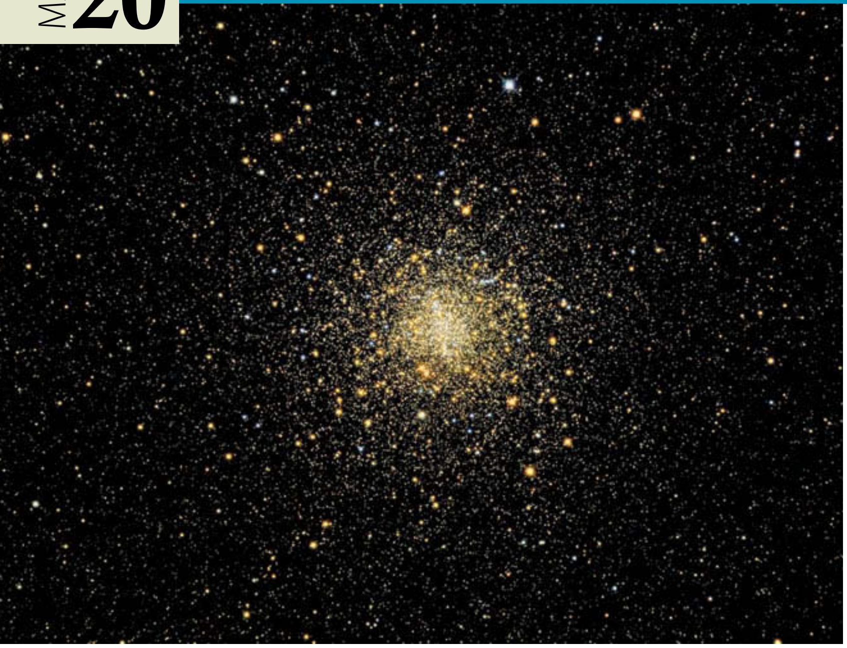
□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

MAP 20 SOUTH EQUATORIAL 5



DANIEL VERSCHATSE

▲ **GLOBULAR CLUSTER M4 in Scorpius lies near the bright reddish star Antares (not shown). M4 is visible easily with the naked eye.**

/// DOUBLE-STAR DELIGHTS — MAP 20

Designation	Right ascension	Declination	Magnitudes	Separation
HJ 4788	15h36m	–44°57'	5.0, 7.0	2.1"
2 Scorpii	15h54m	–25°19'	4.7, 7.4	2.3"
Beta Scorpii	16h05m	–19°48'	2.9, 6.9	13.6"
Sigma Scorpii	16h21m	–25°35'	2.9, 8.7	20.0"
Rho Ophiuchi	16h26m	–23°26'	5.2, 5.9	3.1"
Alpha Scorpii	16h29m	–26°26'	1.2, 5.4	2.9"
Omicron Ophiuchi	17h18m	–24°17'	5.4, 6.9	10.2"
Xi Ophiuchi	17h21m	–21°06'	4.5, 9.0	3.9"
Eta Sagittarii	18h18m	–36°44'	3.2, 7.8	3.6"
Beta^1 Sagittarii	19h23m	–44°27'	4.3, 7.4	28.3"
52 Sagittarii	19h37m	–24°52'	4.7, 9.2	2.6"

Our galaxy's heart

The following star map will keep your telescope's drive humming through many observing sessions. When we look toward this sky region, we face our Milky Way's center, where star clusters and nebulae abound. In Sagittarius alone, we find 15 Messier objects — the largest number in any of the 88 constellations. Scorpius adds four more. We'll start our tour, however, in the small constellation of Norma the Carpenter's Square.

Several nice open star clusters populate the southeastern part of Norma, which lies at the bottom-right of Map 20. Norma continues to Map 24, where we find **NGC 6067**, a magnitude 5.6 naked-eye gem that displays about 100 stars when viewed through a 6-inch telescope. Adding to the appeal of this object is its placement within the Norma Star Cloud, a rich region of the Milky Way. Scopes above 14 inches in aperture will reveal several hundred additional stars.

Norma's other naked-eye open cluster, **NGC 6087** (Map 24), shines at magnitude 5.4 and measures 15' across. Most of its light comes from the variable star S Normae. Every 9.75 days, this star's magnitude varies between 6.1 and 6.8. NGC 6087 contains more than 50 stars visible through 8-inch telescopes, but the field is so crowded with faint background stars that — except for a dozen brighter members — you'll have trouble determining which stars belong to the cluster.

Corona Australis the Southern Crown contains a bright globular cluster, **NGC 6541**. You can see this cluster, which glows at magnitude 6.3, without optical aid if it's high enough in the sky. A 4-inch telescope gives a great view, but, through a 12-inch, you'll see more than 100 outlying stars around a concentrated core.

IC 1297, a magnitude 10.7 planetary nebula, lies 1.5° east of Beta Coronae Australis. You'll need to crank up the magnification on this 7"-diameter object because it appears stellar at low powers. A nebula filter helps because it allows light from the planetary through, but it dims the light from surrounding stars. IC 1297's faint bluish hue is difficult to see in telescopes with apertures less than 16 inches.

Telescopium contains a small cluster of galaxies, and the group makes a good target for a large telescope. The brightest member, **NGC 6868**, glows at magnitude 10.6. Other cluster galaxies include NGC 6861 (26' to the west) and NGC 6870 (7' to the north), but both are several magnitudes fainter than NGC 6868.

In Scorpius, you'll encounter a wealth of deep-sky objects, including four Messier objects: **M4**, **M6**, **M7**, and **M80**. This constellation offers so much more, however. Look 1° northeast of M4, and you'll find another nice globular cluster, although not nearly as bright. **NGC 6144** shines at magnitude 9.0 and measures 9.3' across, about one-third M4's diameter. You'll only see it to about half this diameter, however, unless you use a 12-inch or larger telescope. Be sure to move Antares out of the field of view.

Scorpius is awash in planetary nebulae. Among the best are **NGC 6072** (magnitude 11.7, 40" across), **NGC 6153** (magnitude 10.9, 25" across), and **NGC 6337** (magnitude 12.3, 48" across). By far the best planetary in Scorpius, however, is the **Bug Nebula** (NGC 6302).

Find the Bug surrounded by the Scorpion's tail midway between Lambda and Mu Scorpii. NGC 6302 measures 2' by 1'. A prominent lobe with a tapered end makes up the nebula's western side. A faint extension protrudes from its eastern edge. At magnitude 9.6, NGC 6302 is a bright planetary; use an OIII filter to bring out its subtle details.

Under a dark sky, it would be hard to miss the Scorpius OB1 association, a huge group of hot stars. It begins at Zeta Scorpii and extends northward nearly halfway to Mu Scorpii. The brightest contributor — open cluster **NGC 6231** — lies at the southern end only 32' from Zeta. This magnitude 2.6 gem spans 14' and displays more than 100 stars through 6-inch and larger telescopes. The tight grouping of stars at the cluster's center is particularly striking.

Two beautiful emission nebulae, each measuring roughly ½° across, are must-see objects. First, find the star-forming region known as the **Cat's Paw Nebula** (NGC 6334). The Cat's Paw actually comprises five individual nebulous patches. The one at the southeastern end is brightest.

After you've marveled at the Cat's Paw Nebula, move about 1.8° north-northeast to **NGC 6357**. While you'll see the whole extent of the Cat's Paw, only the west-central region of NGC 6357 — involved with a small star cluster — shines brightly enough for medium-sized scopes.

▲ **OPEN CLUSTER** M7 in Scorpius lies near the Scorpion's stinger. ALLAN COOK/ADAM BLOCK/NOAO/AURA/NSF

ADAM BLOCK/NOAO/AURA/NSF

▲ **THE BUG NEBULA** (NGC 6302) in Scorpius is a strange-looking planetary nebula in which the old star's gas expanded unevenly.

MESSIER OBJECTS IN SAGITTARIUS

Object	Type	Magnitude	Size
M8	N	6.0	45' by 30'
M17	N	7.0	20' by 15'
M18	OC	6.9	10'
M20	N	9.0	20'
M21	OC	5.9	13'
M22	GC	5.2	24'
M23	OC	5.5	27'
M24	SC	2.5	95' by 35'
M25	OC	4.6	32'
M28	GC	6.9	11.2'
M54	GC	7.2	9.1'
M55	GC	6.3	19'
M69	GC	7.4	7.1'
M70	GC	7.8	7.8'
M75	GC	8.6	6'

GC = globular cluster; N = bright nebula; OC = open cluster; SC = star cloud

▲ **M24** (center) is a bright 1.6°-long section of the Sagittarius Star Cloud. This Messier object is an asterism, not a star cluster. M24 lies 10,000 light-years away. CHRIS SCHUR

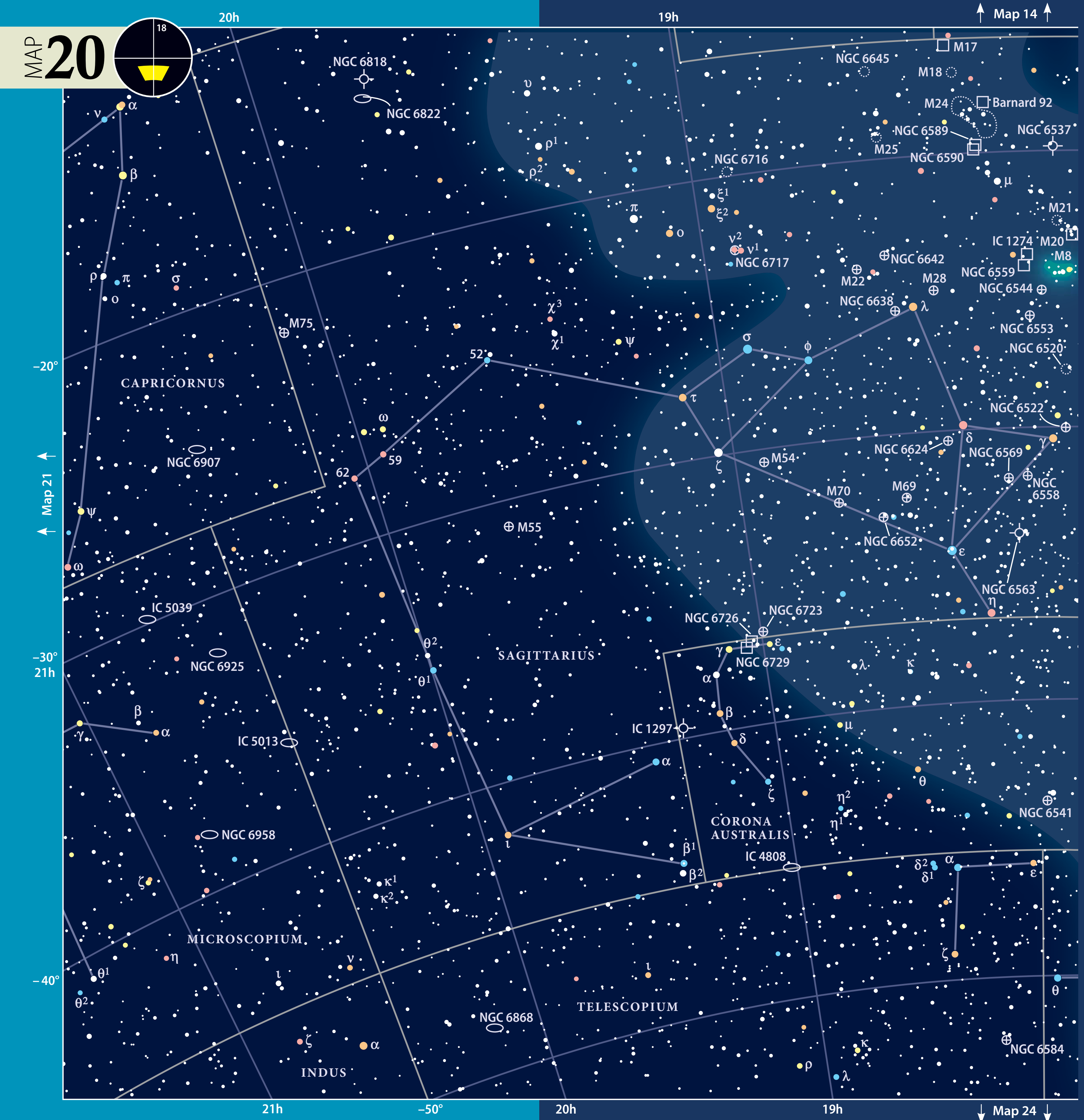
Finally, we arrive at Sagittarius the Archer. For many Northern Hemisphere observers, Sagittarius lies too near the horizon to provide a quality observing experience. For those who live (or can travel to) where the constellation is high in the sky, even a whole season of observing won't be nearly enough to cover all of its deep-sky treats.

In addition to the Messier objects, Sagittarius contains a score of bright deep-sky gems, mainly nebulae and star clusters. One extragalactic target you can find is **Barnard's Galaxy** (NGC 6822). This object is somewhat of an observing challenge. It glows at a respectable magnitude of 8.8, but its light spreads over an area 19' by 15'. This combination means it's a low-surface-brightness object, so you'll need a dark sky to see it. Because NGC 6822 lies only 1.6 million light-years away, you can use a nebula filter with an 8-inch or larger telescope to see HII regions — vast clouds of glowing hydrogen that eventually will form stars.

DANIEL VERSCHATSE

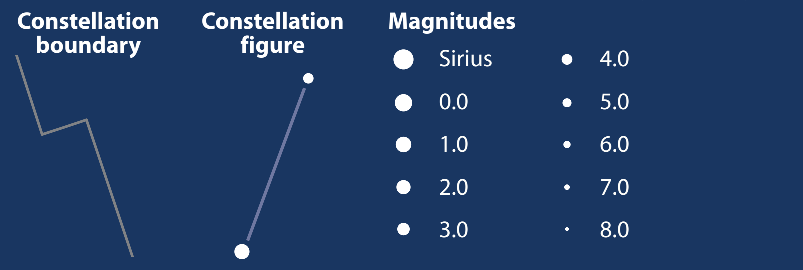
▲ **THE CAT'S PAW NEBULA** (NGC 6334, lower right) complements NGC 6357, which lies less than 2° to its north-northeast.

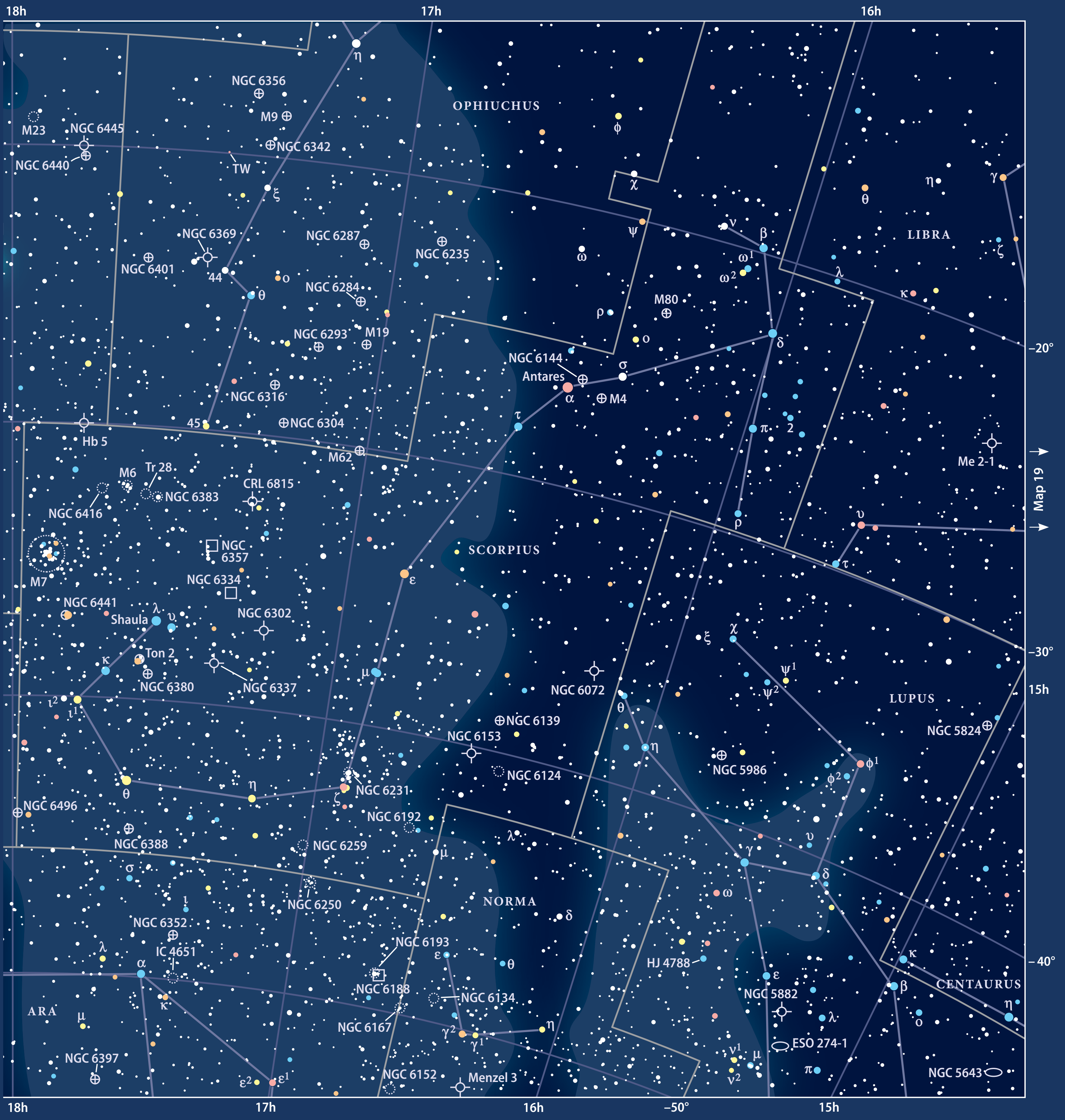
MAP 20


18
20h
19h
Map 14
NGC 6818
NGC 6822
υ
ρ1
ρ2
NGC 6645
M17
M18
M24
Barnard 92
NGC 6589
M25
NGC 6590
NGC 6537
μ
NGC 6716
ξ1
ξ2
π
o
ν2
ν1
NGC 6717
M21
IC 1274
M20
M8
NGC 6642
M22
M28
NGC 6559
NGC 6544
NGC 6638
λ
NGC 6553
NGC 6520
α
ν
β
ρ
π
σ
o
M75
χ3
χ1
ψ
52
σ
φ
τ
CAPRICORNUS
NGC 6522
ω
59
62
NGC 6907
ζ
M54
NGC 6624
δ
NGC 6569
γ
M69
M70
NGC 6558
Map 21
ψ
M55
NGC 6652
ε
NGC 6563
ω
η
NGC 6726
NGC 6723
IC 5039
ε
γ
NGC 6729
θ2
θ1
SAGITTARIUS
λ
κ
α
NGC 6925
β
α
γ
μ
IC 1297
IC 5013
δ
α
ζ
θ
η2
η1
NGC 6541
CORONA AUSTRALIS
NGC 6958
ι
β1
IC 4808
δ2
δ1
α
ε
β2
κ1
κ2
ζ
MICROSCOPIUM
η
ν
ι
ι
ζ
θ1
θ2
θ
TELESCOPIUM
NGC 6868
ζ
α
κ
NGC 6584
INDUS
ρ
λ
-20°
-30°
21h
-40°
21h
-50°
20h
19h
Map 24

SOUTH EQUATORIAL 5

This map shows constellations and deep-sky objects during mid-summer in the Northern Hemisphere and mid-winter south of the equator.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


18h
17h
16h
OPHIUCHUS
SCORPIUS
LIBRA
LUPUS
NORMA
CENTAURUS
ARA
NGC 6356
M9
NGC 6342
M23
NGC 6445
NGC 6440
TW
η
ξ
φ
χ
ψ
ν
β
ω1
ω2
η
γ
θ
ζ
λ
κ
NGC 6369
NGC 6401
44
o
θ
NGC 6287
NGC 6235
NGC 6284
ω
M80
ρ
o
NGC 6293
M19
NGC 6144
Antares
α
σ
M4
δ
NGC 6316
45
NGC 6304
τ
π
2
Hb 5
M62
Me 2-1
M6
Tr 28
NGC 6383
CRL 6815
NGC 6416
ρ
υ
τ
NGC 6357
M7
NGC 6334
ε
NGC 6441
Shaula
λ
υ
NGC 6302
κ
Ton 2
NGC 6380
NGC 6337
μ
NGC 6072
ξ
χ
ψ1
ψ2
ι2
ι1
NGC 6139
NGC 6153
θ
η
NGC 5986
NGC 5824
φ1
φ2
θ
η
NGC 6231
ζ
NGC 6124
NGC 6496
NGC 6192
NGC 6388
NGC 6259
λ
μ
γ
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σ
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NGC 6250
δ
ω
NGC 6352
λ
IC 4651
NGC 6193
ε
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HJ 4788
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NGC 6188
NGC 6134
NGC 5882
β
μ
κ
NGC 6167
γ2
γ1
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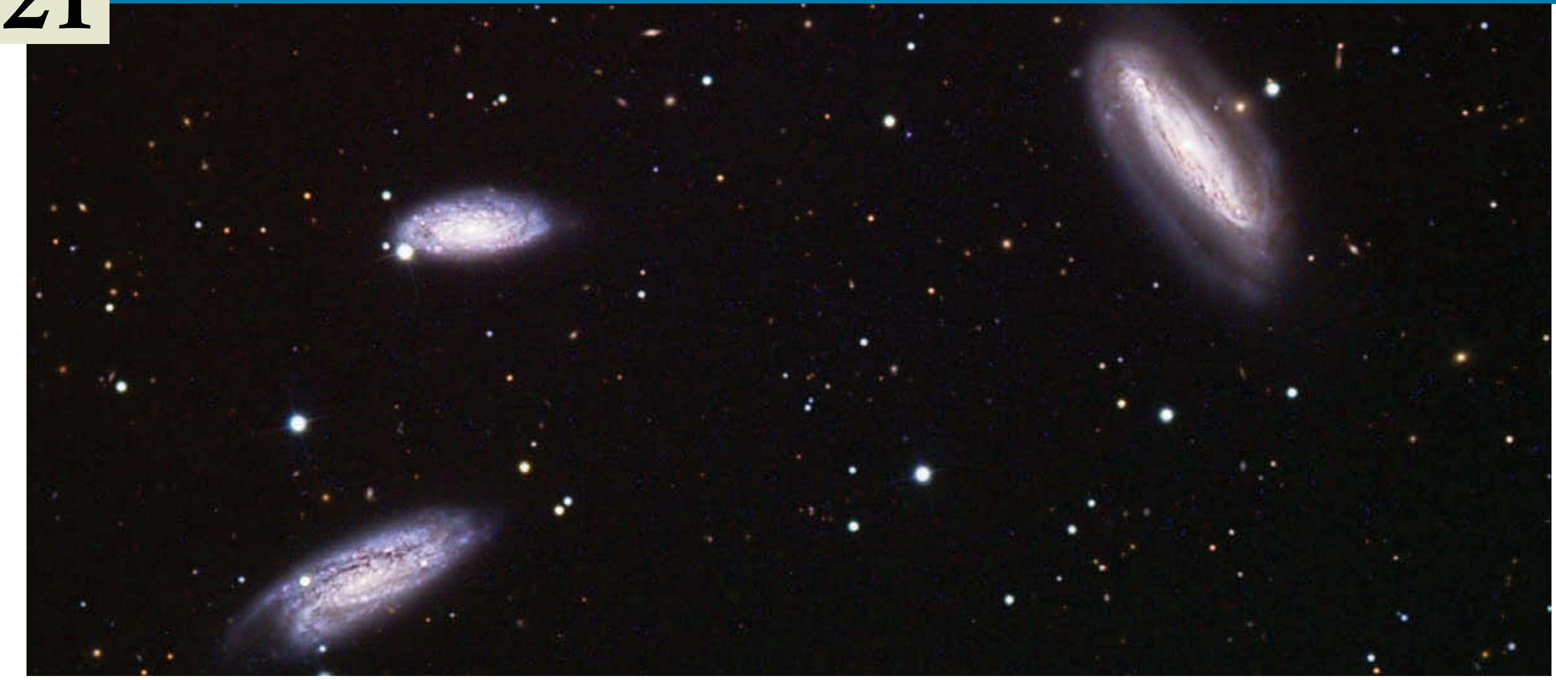
λ
o
η
ESO 274-1
ν1
μ
ν2
π
NGC 6397
ε2
ε1
NGC 6152
Menzel 3
NGC 5643
18h
17h
16h
−50°
15h
−20°
Map 19
−30°
15h
−40°

- ◌ Open cluster
- ⊕ Globular cluster
- □ Diffuse nebula
- ⌖ Planetary nebula
- ⬭ Galaxy

α	Alpha
β	Beta
γ	Gamma
δ	Delta
ε	Epsilon
ζ	Zeta
η	Eta
θ	Theta
ι	Iota
κ	Kappa
λ	Lambda
μ	Mu
ν	Nu
ξ	Xi
ο	Omicron
π	Pi
ρ	Rho
σ	Sigma
τ	Tau
υ	Upsilon
φ	Phi
χ	Chi
ψ	Psi
ω	Omega

MAP 21 SOUTH EQUATORIAL 6



DANIEL VERSCHATSE

▲ **THREE MEMBERS of the Grus Quartet (NGC 7582, right; NGC 7590, upper left, and NGC 7599) lie within 10' of one another. The fourth member (not shown), NGC 7552, lies ½° to the southwest.**

/// DOUBLE-STAR DELIGHTS — MAP 21

Designation	Right ascension	Declination	Magnitudes	Separation
Pi Capricorni	20h27m	–18°12'	5.2, 8.8	3.4"
Omicron Capricorni	20h30m	–18°35'	6.1, 6.6	18.9"
Alpha Microscopii	20h50m	–33°46'	5.0, 10.0	20.5"
Theta Indi	21h20m	–53°26'	4.7, 7.2	6.3"
Zeta Capricorni	21h27m	–22°25'	3.9, 12.5	21.3"
Iota Piscis Austrini	21h45m	–33°01'	4.4, 11.4	20.0"
Delta^1 Gruis	22h29m	–43°29'	4.0, 12.8	5.6"
Gamma Piscis Austrini	22h53m	–32°52'	4.6, 8.1	4.2"
Delta Piscis Austrini	22h56m	–32°32'	4.3, 9.3	4.9"
DUN 246	23h07m	–50°41'	6.1, 6.8	8.7"
Delta Sculptoris	23h49m	–28°07'	4.6, 11.6	3.8"

Southern galaxies

The last of the mid-southern star maps features most of Capricornus the Sea Goat, Microscopium the Microscope, Piscis Austrinus the Southern Fish, and Grus the Crane — the only star figure in this region that resembles its namesake. We've also passed the Milky Way, so many more galaxies appear to populate this region.

Microscopium houses several galaxies that will test your observing prowess through an 8-inch telescope. Look for **IC 5039**. At magnitude 12.6, this object won't blind you, but it's noteworthy because of its interaction with IC 5041, a similarly bright galaxy located only 10' to the north-northeast. IC 5039 appears large with a broad core, while IC 5041's central region appears more concentrated than that of its neighbor.

Move 3° southwest of the galactic pair, and you'll find **NGC 6925**, a magnitude 11.3 spiral galaxy that appears 3 times as long as wide. With a 12-inch scope, you can pick out the irregularly illuminated halo surrounding the moderately bright central region. The core appears stellar.

At magnitude 11.3, **NGC 6958** and NGC 6925 are the brightest galaxies in Microscopium. NGC 6958 measures 2.5' by 2' with a core slightly brighter than its outer regions. NGC 6925 measures 4.4' by 1.1', and it marks the eastern corner of an equilateral triangle 3' on a side. Two 10th-magnitude stars sit at the other corners.

In Grus, several spiral galaxies are worth a look. Center Alpha Gruis in your eyepiece's field of view. Only 16' to the southeast lies **NGC 7213**. Luckily, this magnitude 10.0 galaxy is bright with an evenly illuminated central region. NGC 7213 measures 4.8' by 4.2'.

Next, find the Grus Quartet, the brightest member of which is **NGC 7582**. This galaxy glows at magnitude 10.6 and measures 6.9' by 2.6'. Two other members of the quartet are NGC 7590 (magnitude 11.5) and NGC 7599 (magnitude 11.4). These galaxies, which have similar shapes and sizes to NGC 7582, lie 10' to the northeast. The last member, magnitude 10.7 NGC 7552, sits 0.5° west-southwest of NGC 7582.

Magnitude 10.9 **NGC 7314** sits about 1° northwest of Epsilon Piscis Austrini. This spiral galaxy measures 4.2' by 1.7' and stretches in a north-south orientation. Smaller, fainter NGC 7313 lies only 5' west of NGC 7314, just off the southern tip of the brighter galaxy's outer region.

If you'd like a change from galaxy observing, move into eastern Capricornus and locate globular cluster **M30**. This magnitude 6.9 object measures 11' across. Its core is concentrated, and its outer regions appear irregular through 6-inch and larger telescopes. Through a 10-inch scope at 200x, you'll count 200 stars.

If your telescope measures 16 inches or larger, try for the NGC 7103 galaxy group, 1° north of M30. **NGC 7103** is the brightest member, and it glows at a magnitude of only 12.6. The others are fainter. Don't expect to see detail in these objects — it's a victory just to spot them.

STAR CITIES IN THE UNIVERSE: OBSERVING GALAXIES

You might wonder how objects comprising up to a trillion or more individual stars could be so difficult to observe. Of course, the answer is distance. Galaxies are so far away that, except for a few, they all appear small and faint. Advanced observers regard observing faint galaxies as a challenge.

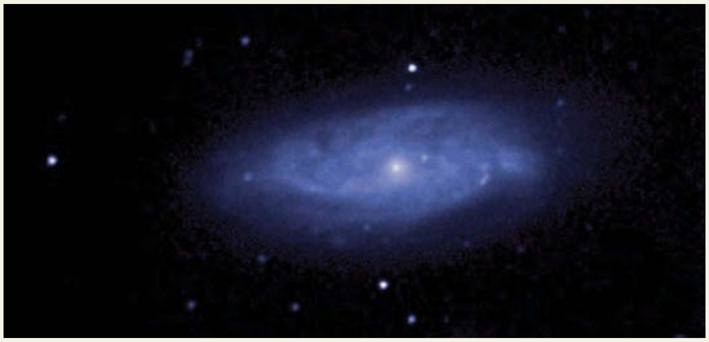
This type of compulsive, competitive observing may not be for you. That's OK. There are lots of galaxies, and we've listed the brightest throughout this atlas.

Visually observing detailed spiral structure, like that seen in images, requires a large telescope — 20 inches or more. Smaller ones will show "mottling," which indicates the presence of spiral arms but does not constitute a true observation of them.

To see detail through medium-sized telescopes, try these Messier galaxies: the Pinwheel Galaxy (M33) in Triangulum (Map 4); the Whirlpool Galaxy (M51) and M106 in Canes Venatici (Map 7); the Black Eye Galaxy (M64) in Coma Berenices (Map 7); M83 in Hydra (Map 19); and M101 and M108 in Ursa Major (Map 2).

Irregulars are the smallest class of galaxies, but most observers find them more interesting to observe than ellipticals, the largest class. Most irregular galaxies are faint, but exceptions exist. The king of irregulars for northern amateur astronomers is the Cigar Galaxy (M82) in Ursa Major (Map 2). In the Southern Hemisphere, by virtue of their nearness, the Large and Small Magellanic Clouds are the greatest galaxies of any type to observe.

Take as long as you need to study these objects. It will be time well spent. NGC 55 in Sculptor (Map 16), NGC 625 in Phoenix (Map 16), NGC 4449 in Canes Venatici (Map 7), Centaurus A (NGC 5128) in Centaurus (Map 19), and Barnard's Galaxy (NGC 6822) in Sagittarius (Map 14) are other relatively bright irregular galaxies.


2MASS

▲ **NGC 7314** is a magnitude 10.9 spiral galaxy located only 1° northwest of Epsilon Piscis Austrini. It measures 4.2' by 1.7'.

Factors that will influence the quality of your galaxy-observing session

1 SIZE MATTERS

If you're trying to observe galaxies through a 4-inch telescope, your observing log will be filled with reports of rough shapes, central condensations, and descriptors like "hinted at," "small," and "faint." There's no way around it. If you want to observe galaxies — really get something out of the time you put in at the eyepiece — you must use a large telescope.

2 BE PATIENT

Rome was not built in a day. Likewise, a galaxy will not give up its secrets in a minute. Begin by noting its overall shape. Is it circular, oval, or rectangular? Next, look at the way the object's brightness spreads out. Is there a central condensation? Are there brighter areas elsewhere? Note the stars in the field of view. How does the galaxy, or its brighter parts, compare with the field stars?

3 CRANK UP THE POWER

Use whatever power eyepiece you must to locate the galaxy you want to observe. Then, increase the magnification. One of the biggest mistakes new observers make is believing a lower magnification will make the galaxy easier to see. In fact, using higher powers increases the contrast between the galaxy and the sky background, so use high power if atmospheric steadiness allows.

4 KEEP AT IT

Experience at the eyepiece is most important when observing galaxies. What looks like a fuzzy blob to beginning observers eventually will reveal a wealth of (albeit faint) details.

5 FORGET ABOUT FILTERS

Galaxies comprise many different types of objects, especially stars. Because of this, if you use a filter of any kind, you're removing some of the light the galaxy emits. This makes a faint object even more difficult to observe.

6 THE SKY WILL DECIDE

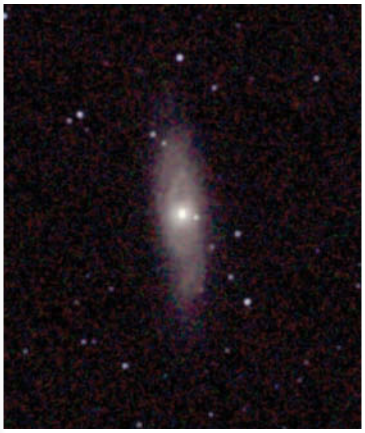
Whether or not your telescope will provide superb views on any given night is a factor out of your control. Just as with planets, double stars, or anything else, the air's steadiness (seeing) sets the limit on how much detail you'll observe.

Some amateurs believe that because galaxies are extended objects, seeing does not affect them as much as observations of double stars. While galaxies tend to be relatively large, the details in them (spiral-arm structure, stellar condensations, etc.) are not, and these details fall prey to the mercy of the night's seeing.

A MEDIUM-SIZED TELESCOPE and a dark sky are essential for an observer hunting galaxies. Look for any central condensation, subtle brightness variations, overall shape, and the extent of the spiral arms.

TIM HUNTER

▲ **GLOBULAR CLUSTER M30 in Capricornus offers a nice break from the many galaxies in this region of sky. M30 glows at magnitude 6.9.**

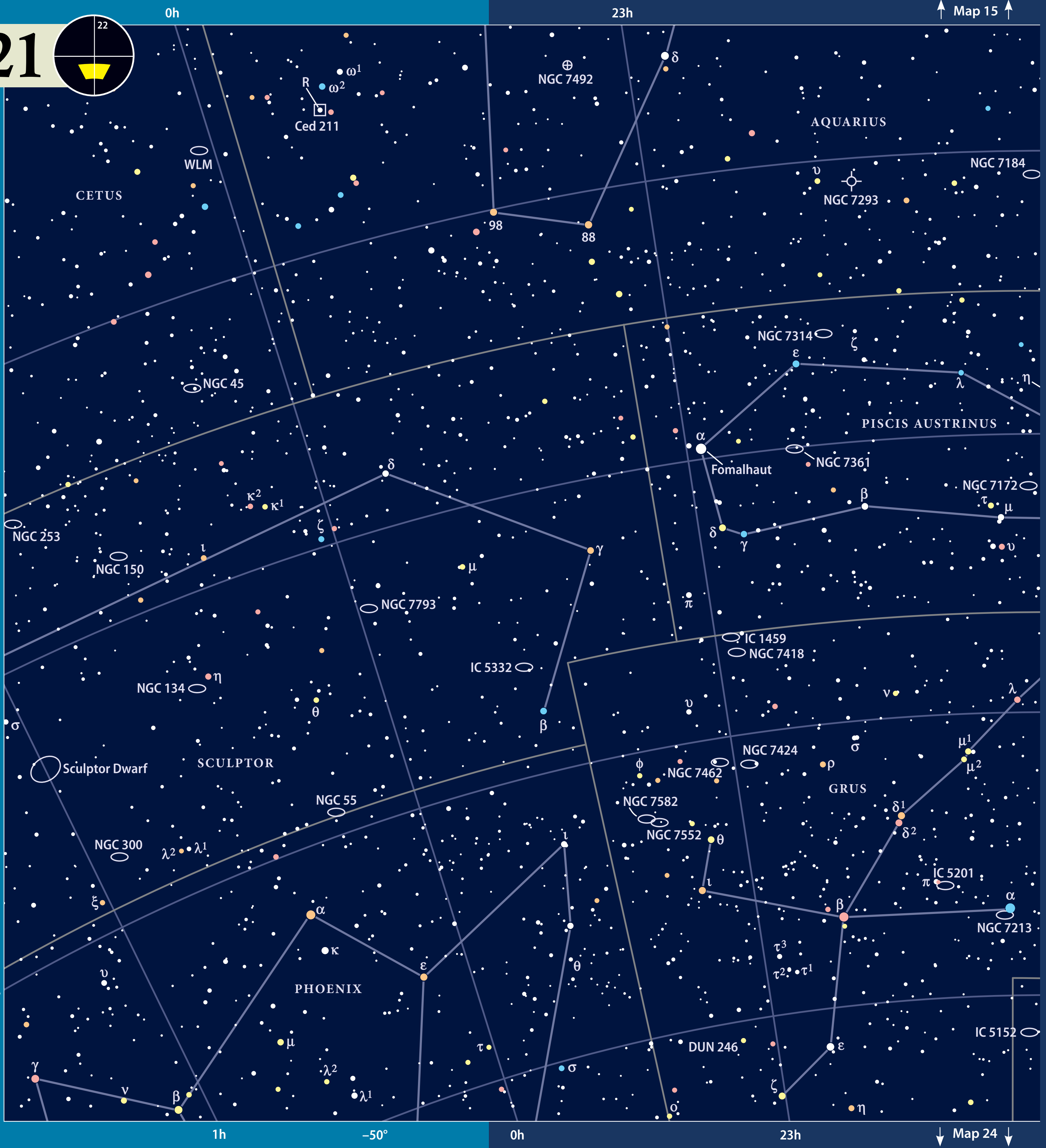

2MASS

▲ **SPIRAL GALAXY NGC 6925 in Microscopium has outer regions that appear irregular, a brighter central area, and a stellar core.**

FRED CALVERT/ADAM BLOCK/NOAO/AURA/NSF

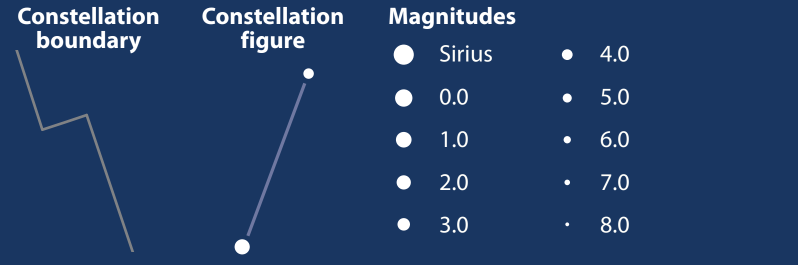
▲ **SPIRAL GALAXY NGC 6907 in Capricornus sports wide spiral arms. At magnitude 11.1, however, you'll need a big scope to see them.**

MAP 21


22
0h
23h
Map 15
Map 16
Map 24
1h
-50°
-20°
-30°
-40°
CETUS
AQUARIUS
PISCIS AUSTRINUS
SCULPTOR
PHOENIX
GRUS
Ced 211
R
WLM
NGC 7492
NGC 7293
NGC 7184
98
88
NGC 45
NGC 253
NGC 150
NGC 7314
NGC 7361
Fomalhaut
NGC 7172
NGC 7793
IC 5332
IC 1459
NGC 7418
NGC 134
Sculptor Dwarf
NGC 55
NGC 300
NGC 7424
NGC 7462
NGC 7582
NGC 7552
IC 5201
NGC 7213
IC 5152
DUN 246

SOUTH EQUATORIAL 6

Use this map early in the evening during mid-autumn north of the equator and mid-spring in the Southern Hemisphere.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
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4.0
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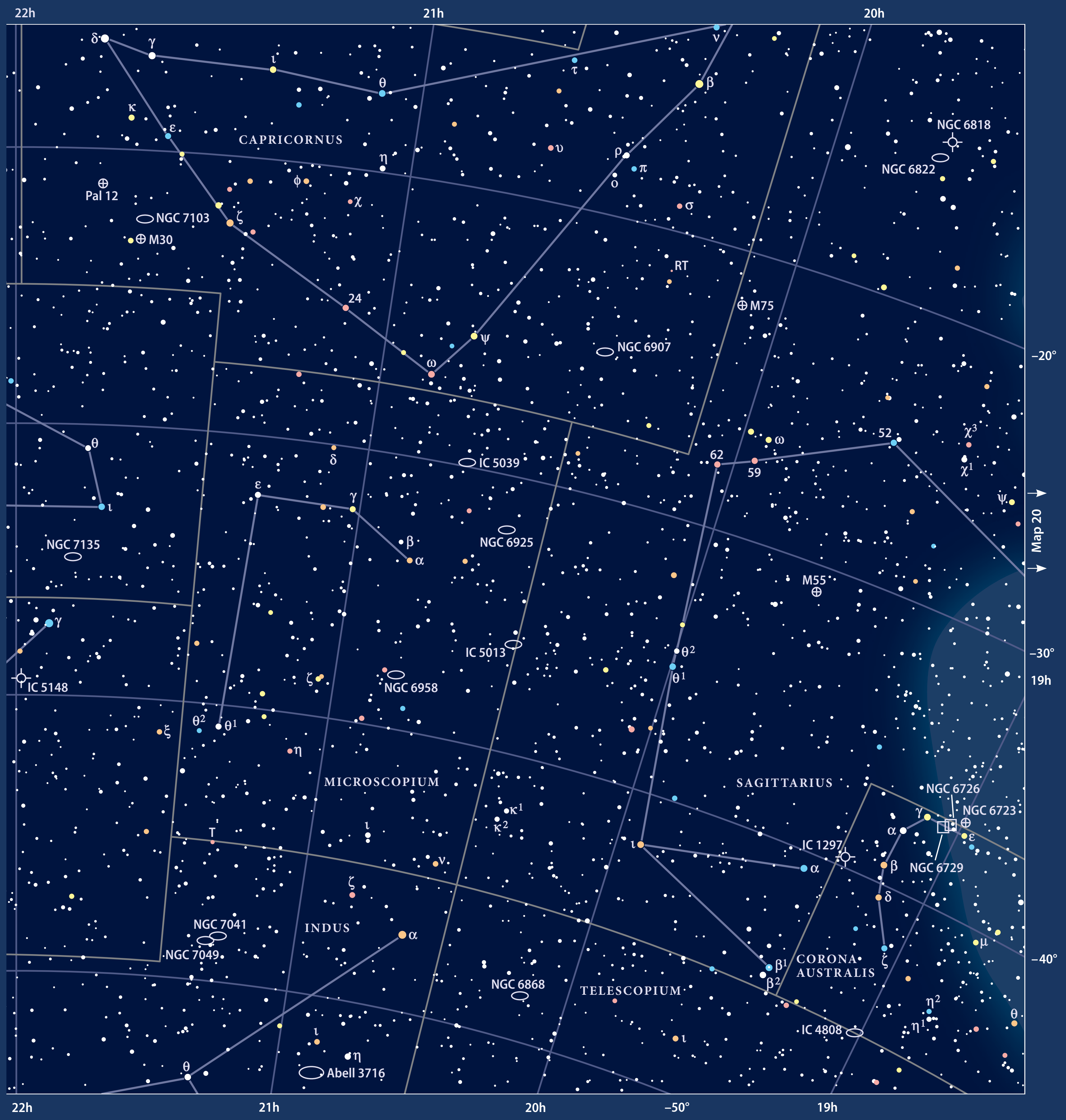
22h
21h
20h
CAPRICORNUS
δ
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θ
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υ
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π
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ϕ
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σ
ζ
Pal 12
NGC 7103
M30
NGC 6818
NGC 6822
RT
24
M75
ψ
ω
NGC 6907
−20°
θ
ι
δ
IC 5039
62
59
ω
52
χ3
χ1
ψ
ε
γ
β
α
NGC 6925
NGC 7135
Map 20
M55
γ
IC 5013
θ2
θ1
−30°
19h
IC 5148
ζ
NGC 6958
θ2
θ1
ξ
η
MICROSCOPIUM
SAGITTARIUS
κ1
κ2
NGC 6726
NGC 6723
γ
α
ε
T
ι
ν
ι
IC 1297
α
β
NGC 6729
ζ
δ
NGC 7041
INDUS
α
μ
NGC 7049
ζ
β1
β2
CORONA AUSTRALIS
−40°
NGC 6868
TELESCOPIUM
η2
η1
θ
IC 4808
ι
ι
η
θ
Abell 3716
22h
21h
20h
−50°
19h

◌ Open cluster

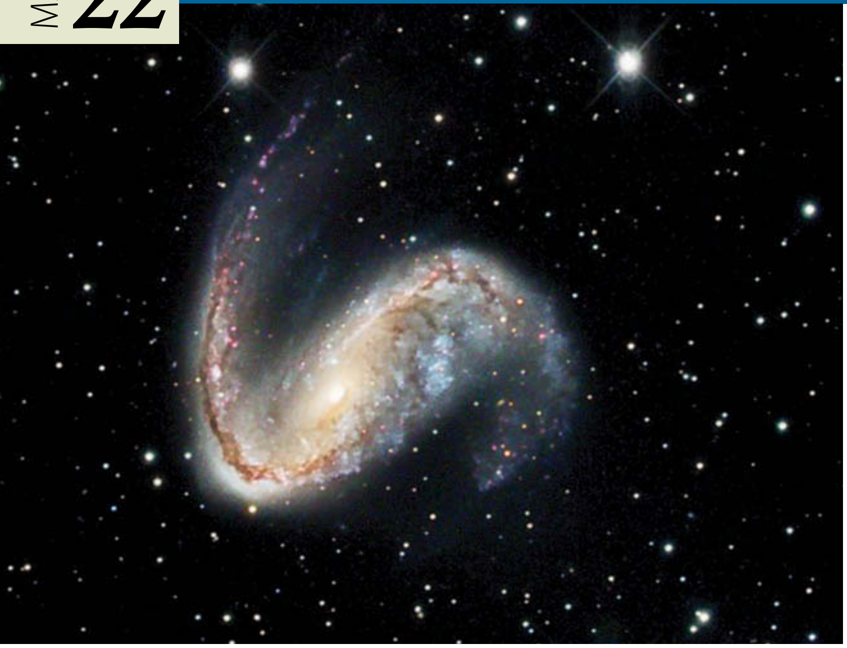
⊕ Globular cluster

☐ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	ϕ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega



DANIEL VERSCHATSE

▲ **BARRED SPIRAL GALAXY** **NGC 2422 shines at magnitude 11.3 and lies 50 million light-years away in Volans the Flying Fish. It appears only 5' across, so use a large scope and high magnification.**

Clouds of Magellan

The next star map contains two spectacular objects — the **Large Magellanic Cloud** (LMC) in Dorado and the **Small Magellanic Cloud** (SMC) in Tucana. They received their names because one of the first Northern Hemisphere inhabitants to describe the clouds was Portuguese explorer Ferdinand Magellan in 1519, during his circumnavigation of the world.

These objects are not earthbound clouds, however, but satellite galaxies of the Milky Way. The LMC lies 170,000 light-years away, and the SMC is 210,000 light-years distant.

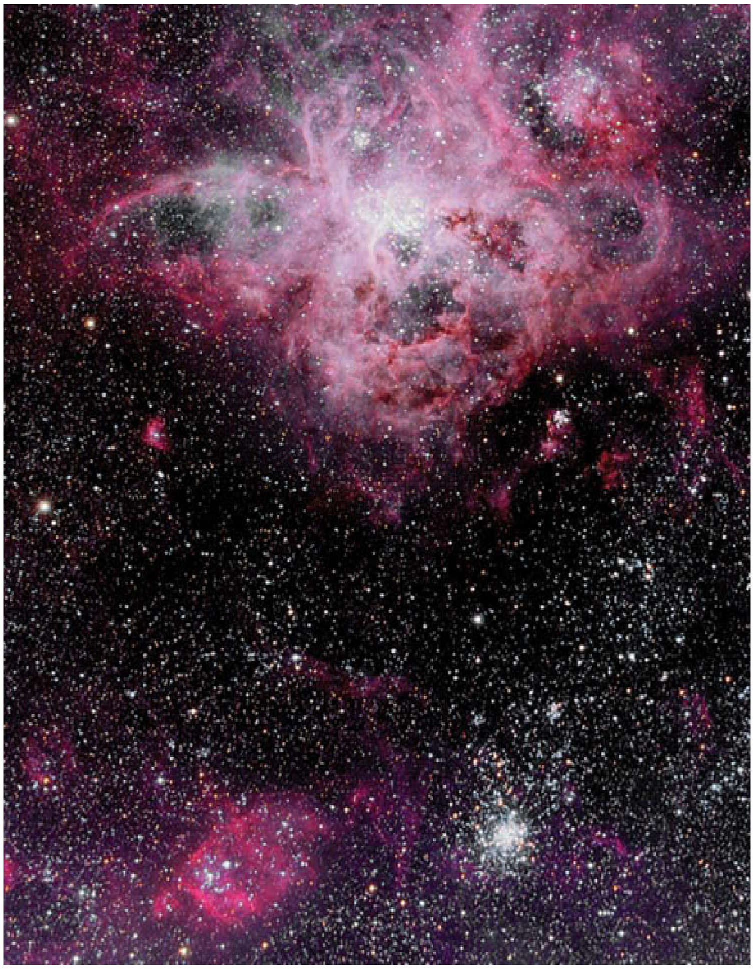
Magnitudes for such extended objects don't mean much, but the LMC shines at approximately 0 magnitude. So, if you took the light from Vega (Alpha Lyrae) and spread it out over an area equal to that of the LMC, it would look about the same. The SMC glows at magnitude 2.3.

The full extent of these galaxies as we see them in the sky is gigantic. The LMC occupies an area roughly 11° by 9°. More than 470 Full Moons would be needed to cover that much sky. The SMC covers a smaller, but still impressive, area — 4.5° by 2.5° (53 Full Moons).

Although the LMC and SMC are small irregular galaxies, many celestial objects within and around them are worth pulling out a telescope for. In the LMC, for example, a 1,000-light-year-wide star-forming region of glowing hydrogen known as the **Tarantula Nebula** (NGC 2070) provides an easy target for telescopes of all sizes.

Near the SMC (but belonging to the Milky Way) is the brilliant globular cluster **47 Tucanae** (NGC 104). This magnitude 4.0 object (the second-brightest globular) lies 13,400 light-years from Earth and covers approximately the same amount of sky as the Full Moon — ½°.

But the Tarantula Nebula and 47 Tucanae are just the beginning. The NGC and IC catalogs tally nearly 400 deep-sky objects in the LMC and an additional 37 in the SMC. To see many of them, you'll need a big telescope, and you'll have to use high magnification. But even through a small telescope or binoculars, these two galaxies will fascinate you.

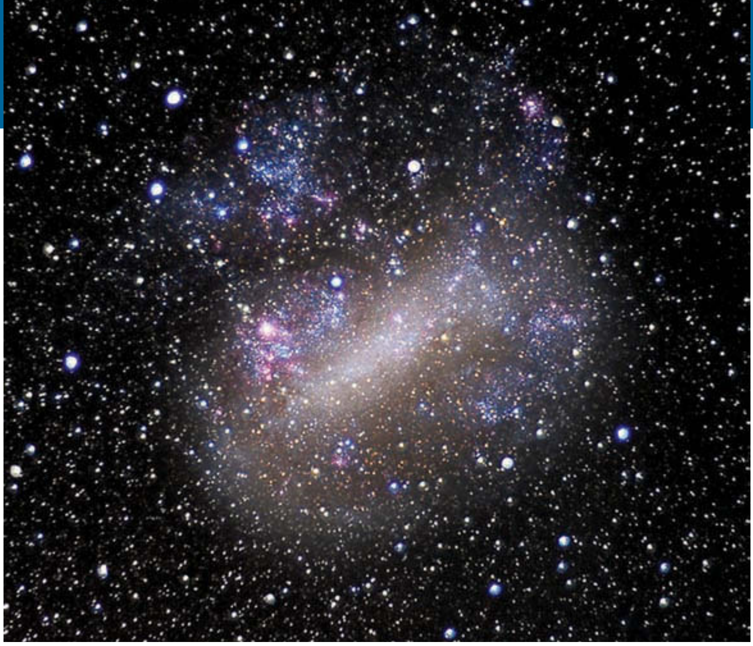


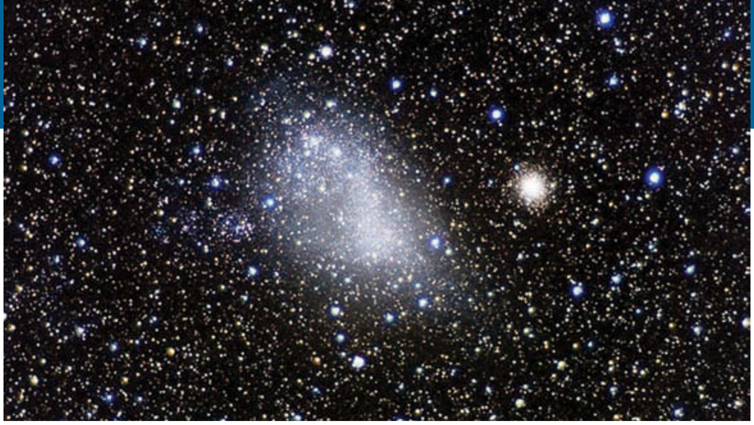
DANIEL VERSCHATSE

▲ **THE TARANTULA NEBULA** **(NGC 2070), which is part of the Large Magellanic Cloud, is the only extragalactic nebula visible to the naked eye. The prominent star cluster near the bottom of this image is NGC 2100.**

DOUBLE-STAR DELIGHTS — MAP 22

Designation	Right ascension	Declination	Magnitudes	Separation
HJ 3435	1h25m	–59°29'	7.0, 9.0	25.5"
COO 14	2h39m	–52°57'	7.4, 8.3	8.8"
Gamma Horologii	2h45m	–63°42'	5.7, 13.0	20.0"
HJ 3568	3h08m	–78°59'	5.7, 9.4	15.2"
Epsilon Reticuli	4h17m	–59°17'	4.4, 12.5	13.7"
Theta Reticuli	4h18m	–63°15'	6.2, 8.2	4.0"
RMK 4	4h24m	–57°04'	7.1, 7.5	5.7"
Iota Pictoris	4h51m	–53°27'	5.6, 6.4	12.5"
Eta^1 Pictoris	5h03m	–49°08'	5.4, 13.0	10.6"
HDO 192	5h30m	–63°55'	6.3, 11.4	9.2"
HJ 3911	6h48m	–76°51'	6.9, 10.4	21.8"
Gamma Volantis	7h09m	–70°29'	3.9, 5.8	13.6"
Zeta Volantis	7h42m	–72°36'	3.9, 9.7	16.7"





DANIEL VERSCHATSE

▲ **THE SMALL MAGELLANIC CLOUD — a satellite galaxy of our Milky Way — covers an area equal to 53 Full Moons. To its right, globular cluster NGC 104, also known as 47 Tucanae, is part of our galaxy.**

◀ **THE LARGE MAGELLANIC CLOUD is the largest of the Milky Way's satellite galaxies. It lies 170,000 light-years away within Dorado and Mensa and shines as brightly as a magnitude 0.4 star.** DANIEL VERSCHATSE

HOW TO GET THE MOST OUT OF STAR PARTIES AND OBSERVING SESSIONS

Amateur astronomers attend two types of social events: astronomy club meetings and star parties. Here are some guidelines to help you get the most out of your first (or next) star party:

1 Follow all posted instructions. Many star parties provide instruction sheets. Whether this is your first star party or your fiftieth, read and memorize the list.

2 Avoid using any light. While white light is more detrimental to dark-adapted eyes, most red lights are too bright. And the brightness of the light — not its color — unadapts your eye. So if your star-party light is a big red spotlight, leave it in your car.

3 Before you go to a star party or observing session, deal with your vehicle's lights, especially those activated by open doors, hoods, or trunk lids. The easiest method? Simply pull the bulbs.

4 Clean up after yourself. Don't leave litter lying around where the wind can blow it about or someone else can encounter it. Don't count on a trash receptacle being on site — bring one of your own. At the end of your observing session, perform a "white-light survey" (if nobody else is observing) to check for trash and other items.

5 Check with the organizers about restroom facilities before the event. You can save yourself some concern, and probably a lot of unnecessary steps, if you know what to expect.

6 Take your time when looking through someone else's telescope. A quick glance does you no good and, quite frankly, it doesn't leave the best impression on the telescope owner either. Just about all amateur astronomers love to answer questions.

7 With regard to viewing through someone else's telescope — focus. Our eyes are not all the same. Even focusing a small amount can reveal details that were invisible before. If you're unfamiliar with the telescope through which you're observing, simply ask, "Excuse me, how do I focus your telescope?"

8 Bring your children. Control your children. Star parties are family affairs, and children are welcome; however, make certain they stay with you at all times. Many children become cranky if they stay up too late. Always remember that their comfort and safety is your first concern. Tip: Children don't do well at all-night observing sessions.

9 If you must have music, you may be in the wrong place. Realize that individual taste in music varies so widely that you can be certain someone nearby doesn't like what you're listening to.

10 If you must drive, minimize the amount of dust you send into the air by driving slowly. Many star parties, especially in drier climates, are held at heavily used sites with little vegetation.

11 Unless you have a motor home, don't bring your pets with you to star parties. Amateur astronomers seem to have a strong distaste for stepping in — or setting a case or piece of equipment in — animal droppings.

12 Bring a chair. Don't count on others to have extra. If you're attending an observing session or evening gaze, bring a beverage and a light snack. If you're attending a several-night star party, you'll want to bring a lot more. In warmer seasons, bring insect repellent.

13 Never move somebody else's telescope without permission. If the object is drifting out of the field of view, mention this to the telescope's owner.

14 Check the rules before you smoke. A fire hazard may exist. Note the direction the breeze is blowing and be mindful of others who may not appreciate second-hand smoke.

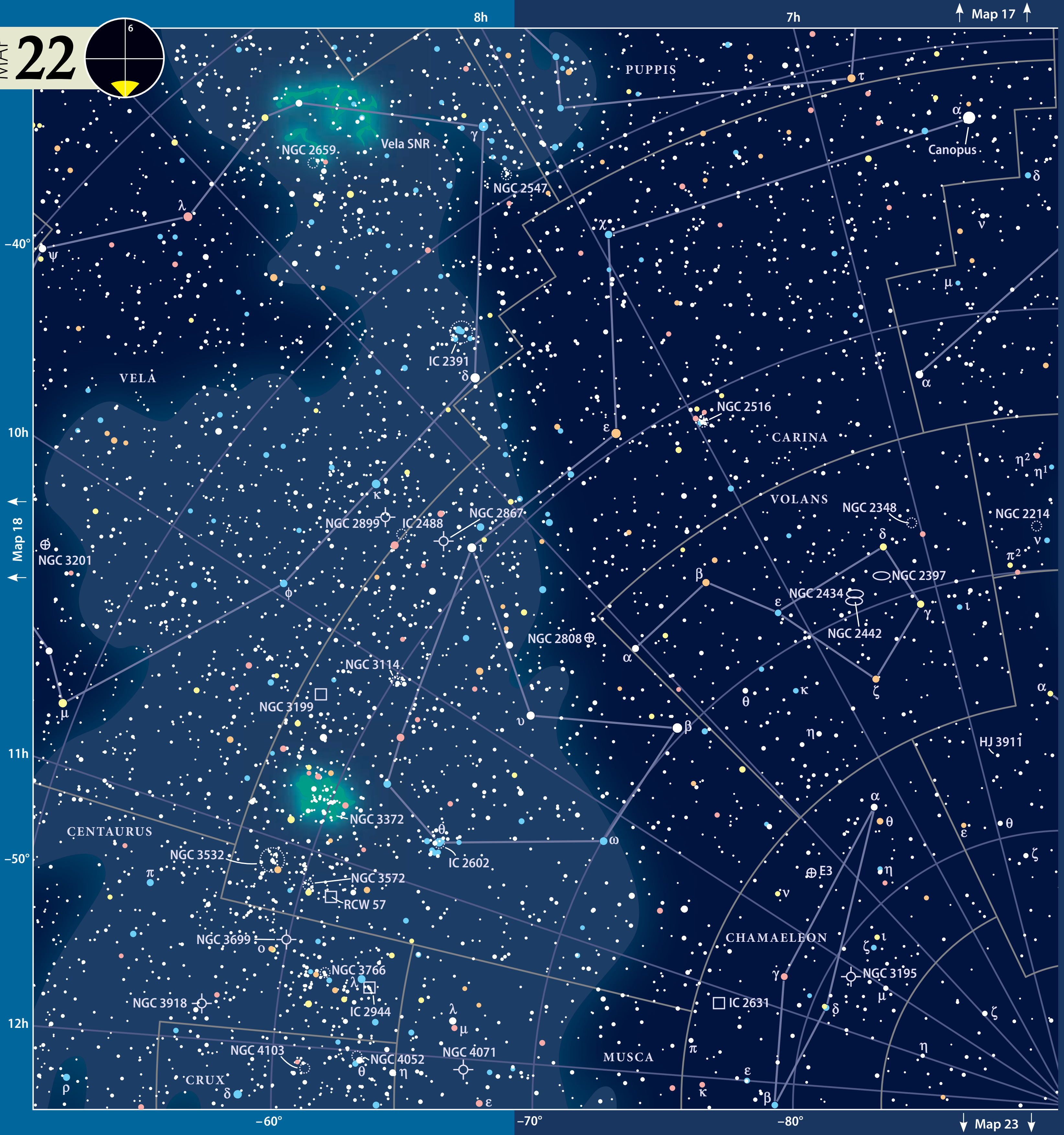
15 Be aware of imagers. Use no lights in the area, and don't walk in front of their telescopes. Some amateurs who live in harsh climates look at the generally clearer, darker, drier sites star parties provide as a way to acquire new images, rather than as a nighttime social event.

16 Arrive before dark if possible, for two reasons: Observers frown on lights from vehicles after they set their telescopes up. Secondly, you may not be able to find the location in the dark. Star parties generally occur at remote sites, making them nearly impossible to find after sunset (even with directions). If you have any doubt about your ability to get there, visit the location in the daytime.

17 If your vehicle has lights you'll be using, let others know you're leaving in case someone is imaging. For the cost of a few minutes' time, you can avoid making an enemy.

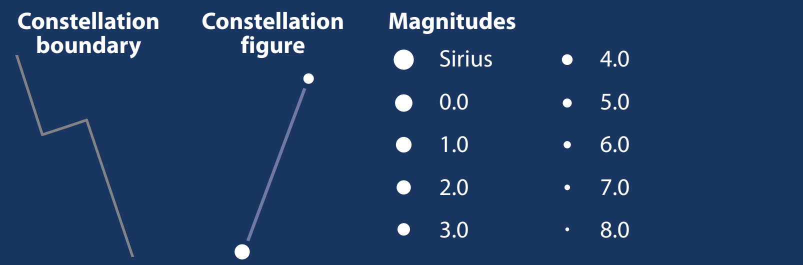
18 Finally, be courteous. The people with telescopes are not being paid. Most are either members of an astronomy club or their spouses. The other attendees are visitors just like you.

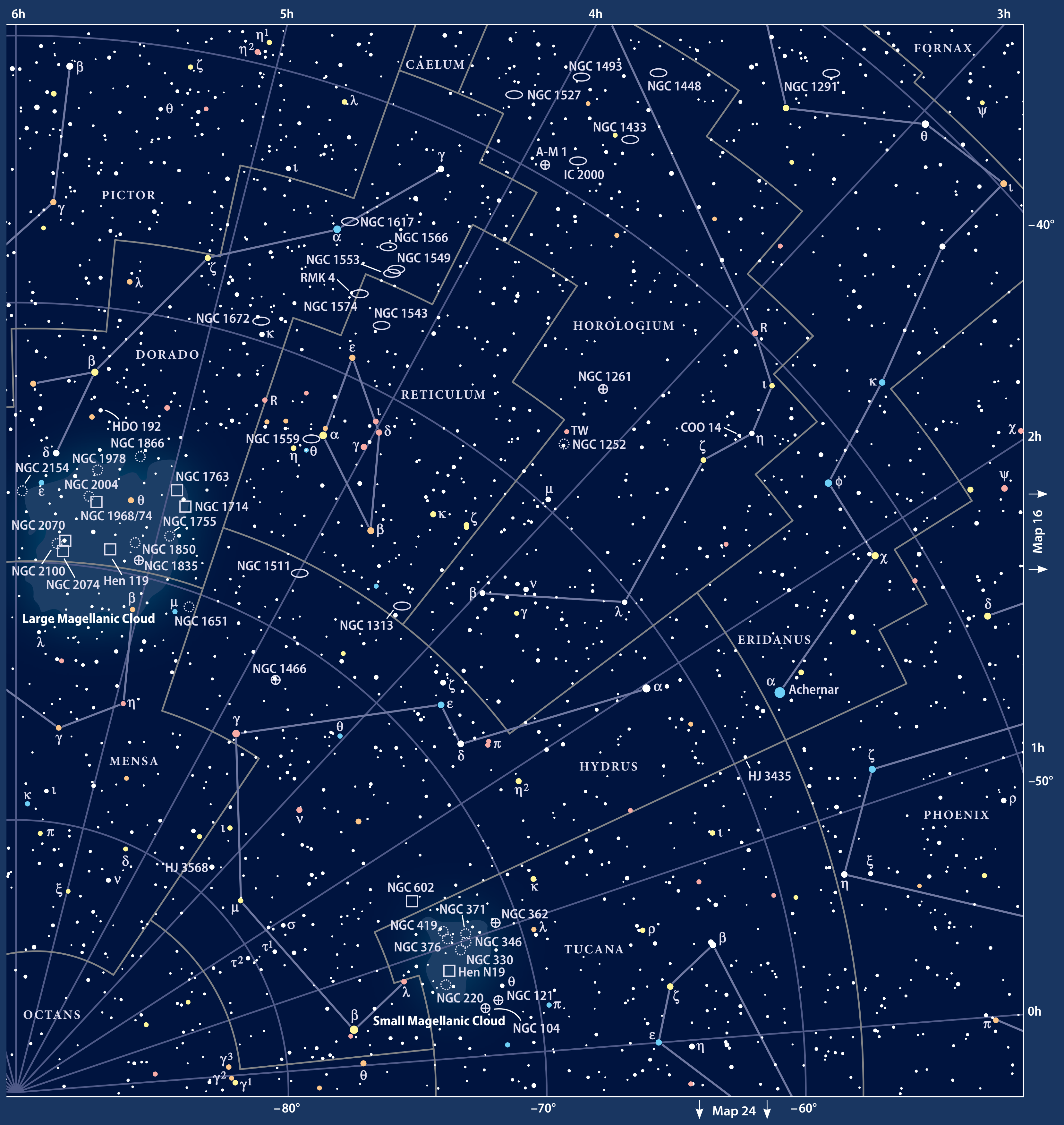
MAP 22


6
8h
7h
Map 17
PUPPIS
τ
α
Canopus
δ
ν
μ
γ
Vela SNR
NGC 2659
NGC 2547
λ
ψ
−40°
χ
VELA
IC 2391
δ
α
10h
NGC 2516
ε
CARINA
η²
η¹
VOLANS
NGC 2348
NGC 2214
κ
NGC 2899
IC 2488
NGC 2867
ι
Map 18
NGC 3201
δ
ν
π²
NGC 2397
β
ε
NGC 2434
γ
ι
φ
NGC 2442
NGC 2808
α
NGC 3114
ζ
κ
θ
α
NGC 3199
μ
υ
β
HJ 3911
11h
η
NGC 3372
α
θ
ε
θ
CENTAURUS
θ
ω
ζ
NGC 3532
IC 2602
−50°
π
E3
η
NGC 3572
ν
RCW 57
NGC 3699
ο
CHAMAELEON
ι
ζ
NGC 3195
NGC 3766
λ
γ
μ
NGC 3918
IC 2944
IC 2631
δ
ζ
λ
12h
μ
π
η
NGC 4103
NGC 4052
NGC 4071
MUSCA
θ
η
ε
ρ
CRUX
δ
ε
κ
β
−60°
−70°
−80°
Map 23

SOUTH POLAR 1

From southern latitudes, you'll see this map's area best in the summer. Most of these objects are invisible to Northern Hemisphere observers.


Constellation boundary
Constellation figure
Magnitudes
Sirius
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


6h
5h
4h
3h
CAELUM
FORNAX
PICTOR
DORADO
RETICULUM
HOROLOGIUM
ERIDANUS
MENSA
HYDRUS
PHOENIX
TUCANA
OCTANS
NGC 1493
NGC 1448
NGC 1291
NGC 1527
NGC 1433
A-M 1
IC 2000
NGC 1617
NGC 1566
NGC 1553
NGC 1549
RMK 4
NGC 1574
NGC 1543
NGC 1672
NGC 1261
TW
NGC 1252
COO 14
R
HDO 192
NGC 1866
NGC 1559
NGC 1978
NGC 2154
NGC 2004
NGC 1763
NGC 1714
NGC 1968/74
NGC 1755
NGC 2070
NGC 1850
NGC 1835
NGC 2100
NGC 2074
Hen 119
Large Magellanic Cloud
NGC 1651
NGC 1511
NGC 1313
NGC 1466
Achernar
HJ 3435
HJ 3568
NGC 602
NGC 371
NGC 362
NGC 419
NGC 346
NGC 376
NGC 330
Hen N19
NGC 220
NGC 121
Small Magellanic Cloud
NGC 104
–40°
2h
Map 16
1h
–50°
0h
–80°
–70°
Map 24
–60°

◌ Open cluster

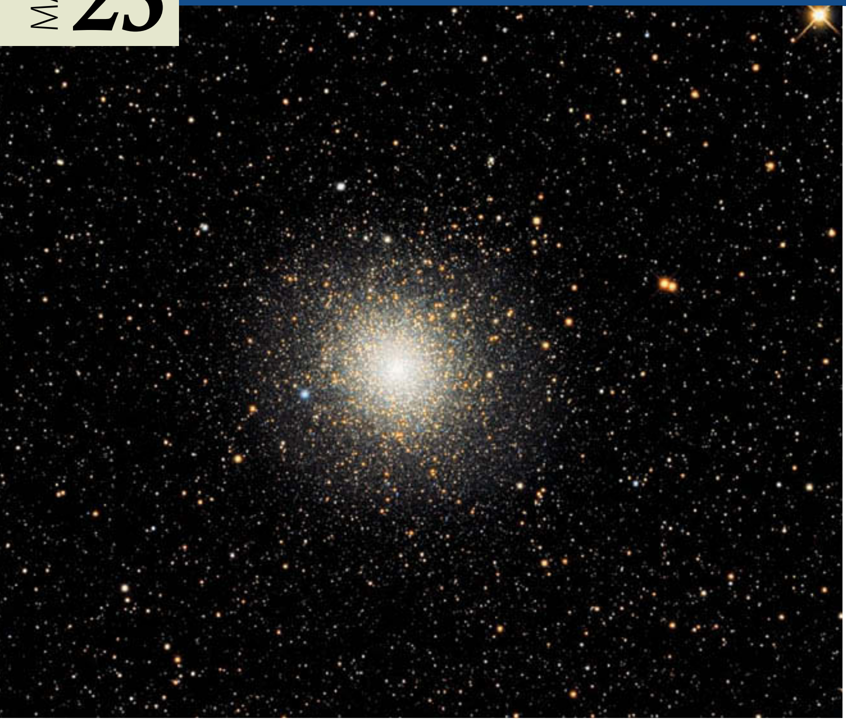
⊕ Globular cluster

□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi
δ	Delta	κ	Kappa	π	Pi	χ	Chi
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega



DANIEL VERSCHATSE

▲ **GLOBULAR CLUSTER** NGC 2808 in Carina shines at magnitude 6.2, making it visible to the naked eye from a dark site. The double star to the right of the cluster has reddish components of magnitudes 10.0 and 10.6.

DANIEL VERSCHATSE

▲ **THE JEWEL BOX CLUSTER** (NGC 4755) is a beautiful celestial object through any size telescope. This 4th-magnitude open cluster is 10' across.

/// DOUBLE-STAR DELIGHTS — MAP 23

Designation	Right ascension	Declination	Magnitudes	Separation
RMK 8	8h15m	–62°54'	5.3, 8.0	3.9"
HJ 4156	8h55m	–60°39'	4.0, 12.8	21.1"
HJ 4206	9h17m	–74°53'	5.5, 10.0	7.1"
Upsilon Carinae	9h47m	–65°03'	3.1, 6.1	5.0"
DUN 94	10h39m	–59°11'	4.8, 8.2	14.5"
Omicron[1] Centauri	11h32m	–59°26'	5.0, 11.4	13.5"
Lambda Centauri	11h36m	–63°01'	3.3, 11.5	16.3"
Gamma Crucis	12h32m	–57°06'	1.6, 6.7	10.6"
Alpha Muscae	12h37m	–69°08'	2.9, 13.0	29.6"
Iota Crucis	12h46m	–60°58'	4.7, 9.5	27.0"
Theta Muscae	13h08m	–65°18'	5.9, 7.5	5.3"
Alpha Circini	14h43m	–64°57'	3.4, 8.8	15.7"

Southern jewels

The accompanying map contains plenty to observe, including all of Crux the Southern Cross, the smallest of the sky's 88 constellations. You can see something interesting just looking at Crux without optical aid. Near its brightest star, Alpha Crucis, is a dark, 4°-wide swath of sky called the **Coalsack**. Only one 5th-magnitude star intrudes here.

On the eastern edge of Crux, the **Jewel Box Cluster** (NGC 4755) also is visible to the naked eye. This clump of colorful stars contains at least 25 members brighter than 12th magnitude and looks great through any size telescope. Three bright stars — one yellow, one blue, and one orange — form a line across the cluster's center. The rest of the stars are white and form a sparkly background to the three luminaries.

Planetary nebula **NGC 4071** lies 2° east-southeast of Lambda Muscae. Long-exposure images show it is an ellipse flanked by bright ends and containing a bar that crosses the nebula's minor axis. Through a 12-inch or larger telescope, NGC 4071 appears like a ghostly oval bubble about 1' across with a diffuse edge. A 13th-magnitude star appears near the center, but this is not the planetary's true central star, which is 19th magnitude. An OIII filter is a must if you want to see any of this object's details.

Only 0.7° southwest of Gamma Muscae lies **NGC 4372**, one of the least-concentrated globular clusters. At a distance of 15,000 light-years, its brightest stars glow at 12th magnitude and are visible easily through small telescopes. An 8-inch scope shows NGC 4372 as a loose collection of 13th- and 14th-magnitude stars spread over an area 19' across.

This cluster shows almost no concentration toward its center; at 150x, it looks like a circular open cluster. Through a 14-inch or larger scope, you can resolve NGC 4372 to the core, and it becomes a magnificent collection of mostly equal-magnitude stars with no background glow.

A more typical globular cluster is nearby **NGC 4833**, a nice contrast to NGC 4372. This is a moderately concentrated ball of stars that resolves well through 6-inch scopes. Use a 10-inch telescope, and you'll see dozens of 13th-magnitude cluster stars. Unlike NGC 4372, the broadly concentrated core displays a haze of unresolved stars.

The central region of NGC 4833 is its most concentrated area. It appears like an oval stretched both east and west. This globular shines at magnitude 7.8, measures 13.5' across, and lies 25,000 light-years away.

Don't miss 10th-magnitude **NGC 5189** some 5.8° northeast of NGC 4833. This planetary nebula is a real oddball. At 5,000 light-years away, NGC 5189 is 2' across. Sometimes called the Barred Spiral Nebula because of its resemblance to a barred spiral galaxy through small telescopes, this planetary displays an S shape that's hard to miss.

Be sure to explore the small constellation Chamaeleon because it contains one of the highlights of the south polar region: planetary nebula **NGC 3195**. Although it glows at a paltry magnitude 11.6, this object's high surface brightness allows you to use high magnification to study it.

If your sky permits, use at least 200x on the 40" disk to reveal a slight north-south elongation and subtle brightness differences along NGC 3195's minor axis. The central star — listed at magnitude 15.3 — is a test only for the largest amateur telescopes because of the nebula's brightness.

REMOTE OBSERVING: WHEN YOU'RE READY TO HEAD TO A DARK-SKY SITE

As observers, nothing is more fun than a trip to a dark-sky site. Most of the time, we know both the site and the conditions we may encounter, but not always. Unfamiliar surroundings and bad weather can be dangerous. Here are a few tips to keep in mind before you head out:

Observing alone

If you must observe at a remote site alone, double-check everything. Before going out, let someone know where you will be and how long you plan to be out. This is not the time to be picking an unfamiliar location at random. Your life may depend on somebody knowing where you are.

Just in case

Keep a Mylar blanket with your equipment. Often billed as a "survival blanket," that's exactly what one may be to you. Wrapped around you, a Mylar blanket traps body heat, allowing you to survive at low temperatures. As a cover for your sleeping bag, a Mylar blanket will keep you warmer, provide a shield against the wind, and protect your bag from dew or frost. These blankets also are waterproof.

Lightning

Get to a safe place if lightning is anywhere nearby. Think of yourself and others first, but also remember large electrical discharges from lightning can damage sensitive equipment like telescope drives and computers.

Morning caution

Occasionally, you'll find you've observed all night. Congratulations! In the morning, point your telescope westward, away from the rising Sun. This is crucial if you're leaving your telescope uncovered. Focused sunlight can crack optics. A good option is to cover your scope with a reflective cover.

Mosquitoes

Carbon dioxide (which we exhale) attracts mosquitoes most, followed by the heat (infrared) we emit. Swatting at them will cause them to swarm around you. Clothing colors are not important to mosquitoes because the other attractions are so much stronger.

Lotions or sprays containing DEET, the acronym for N,N-diethyl-meta-toluamide, are most effective. Use products with no more than 34 percent DEET (10 percent for children 2 to 12) because higher concentrations can cause toxic reactions. Do not use DEET on children under 2, pregnant women, or on children's clothing.

While most people apply repellent only to exposed skin, experts suggest treating adult clothing as well. Most fabrics are only 1 millimeter thick, if that, but a mosquito's proboscis is 2mm long and can penetrate most clothing.

Sunlight

Exposure to bright sunlight has a cumulative effect on your eyes' dark adaption. Reflective surfaces such as sand, snow, and water intensify this condition. Exposure to intense sunlight for 2 to 5 hours decreases visual sensitivity for up to 5 hours. In addition, the rate of dark adaption and the degree of night visual acuity decrease. These effects may persist for several days.

Tents

If you're tent-camping, consider a second tent for your equipment. Such a setup will keep things dry, relatively dust-free, and out of direct sunlight. It will also give you a lot more room in your sleeping tent. Before erecting a tent, lay a plastic tarp on the ground.

Also, forget about the plastic stakes that come with most small tents. Most are flimsy and will bend in hard ground. Instead, use large steel spikes, which you can find at most hardware stores. They should be roughly 8 inches long, ⅜-inch in diameter, and with a head at least ½-inch wide.

Winter observing

The rule is simple: Preparation is everything.

Being prepared does not only mean owning the right equipment. It means having what you need at hand for what you didn't expect. If you're observing in winter at a remote site, please, for your own sake, overpack. It's improbable you'll need everything you bring. But having the right items could prevent a miserable experience.

Remember, observing is, for the most part, a stationary activity. So, if you're unprepared, you'll chill quickly. The most important body parts to keep warm are the head and the feet. Most heat loss during cold evenings is through the top of the head. And heat seeping into the ground through thin shoes also chills observers trying to stay warm.

Buy the best boots you can afford that allow you to drive a vehicle. You usually will change into them at your observing site, but you never can tell what might happen. Choose boots that are comfortable, light, and have a thick, insulated lining in the sole.

Bring hand warmers, and bring extras. They're superb when working but notorious for not lasting the full time specified on the package. Slip them in your gloves or mittens for a quick warm-up. Toe warmers are available for cold feet.

Dress in layers. Your observing attire should resemble this: soft fleece pullover head cover; hat; fleece long underwear; pants; T-shirt; thin, long-sleeved flannel shirt; fleece pullover; down jacket. Some observers sensitive to the cold wear a ski rescue suit. When fully zipped with the hood up and boots and gloves in place, the wind will find few places to chill you.

Choose a sleeping bag with the appropriate temperature range for your area. Don't sleep directly on the ground. Fold-out platforms are available. Some observers place an air mattress on such a frame.

DANIEL VERSCHATSE

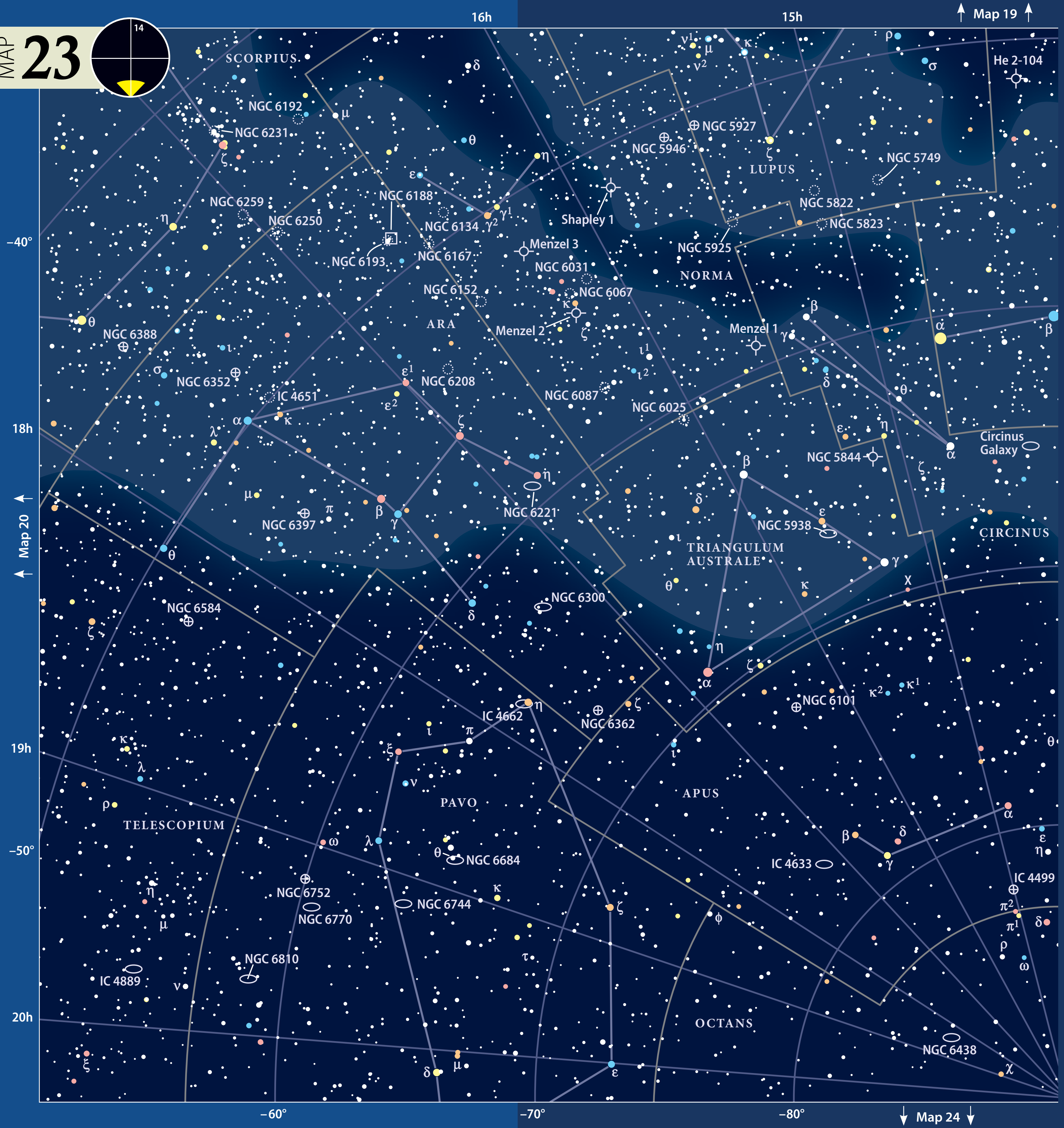
▲ **NGC 4372 IN MUSCA is a round, magnitude 7.8 globular cluster that measures 19'. It lies 0.7° southwest of magnitude 3.8 Gamma Muscae.**

DANIEL VERSCHATSE

▲ **THE SPIRAL NEBULA (NGC 5189) is so-called because of its strange S shape. This unusual magnitude 10 planetary nebula measures 2.4' by 1.5' and resides in Musca the Fly.**

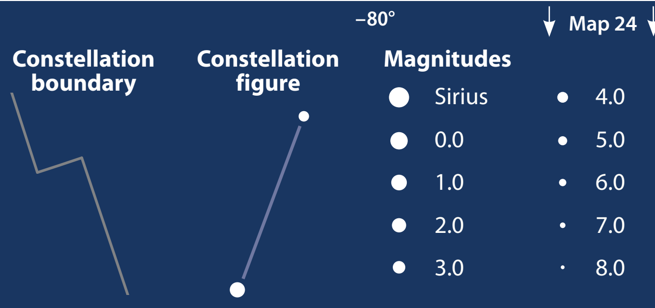
DANIEL VERSCHATSE

▲ **GLOBULAR CLUSTER NGC 4833 lies in Musca the Fly and shines at magnitude 7.8. With a diameter of 13.5', NGC 4833 is slightly less than half the width of the Full Moon.**


16h
15h
Map 19
14
SCORPIUS
δ
NGC 6192
μ
NGC 6231
ζ
θ
η
ε
NGC 6188
γ1
γ2
NGC 6259
NGC 6250
NGC 6134
η
NGC 6193
NGC 6167
Menzel 3
NGC 6031
NGC 6067
NGC 6152
κ
θ
ARA
Menzel 2
ζ
NGC 6388
ι
σ
NGC 6352
IC 4651
ε1
NGC 6208
ε2
NGC 6087
NGC 6025
ι1
ι2
α
κ
λ
ζ
η
μ
NGC 6397
π
β
γ
NGC 6221
θ
δ
NGC 6300
NGC 6584
ζ
ν1
μ
ν2
κ
ρ
σ
He 2-104
NGC 5927
NGC 5946
ζ
LUPUS
NGC 5749
Shapley 1
NGC 5822
NGC 5823
NGC 5925
NORMA
β
Menzel 1
γ
α
β
δ
θ
ε
η
Circinus Galaxy
NGC 5844
ζ
β
δ
ε
NGC 5938
γ
CIRCINUS
ι
TRIANGULUM AUSTRALE
θ
κ
χ
η
α
ζ
κ2
κ1
NGC 6101
IC 4662
η
NGC 6362
ζ
ξ
ι
π
ν
ι
APUS
θ
κ
λ
ρ
TELESCOPIUM
PAVO
ω
λ
θ
NGC 6684
β
δ
α
γ
ε
η
IC 4633
IC 4499
η
μ
NGC 6752
NGC 6770
NGC 6744
κ
ζ
φ
π2
π1
δ
ρ
ω
NGC 6810
IC 4889
ν
τ
OCTANS
NGC 6438
ξ
δ
μ
ε
χ
−40°
18h
Map 20
19h
−50°
20h
−60°
−70°
−80°
Map 24

SOUTH POLAR 2

From southern latitudes, you'll see this map's area best in the winter. Most of these objects are invisible to Northern Hemisphere observers.


Constellation boundary
Constellation figure
Magnitudes
Sirius
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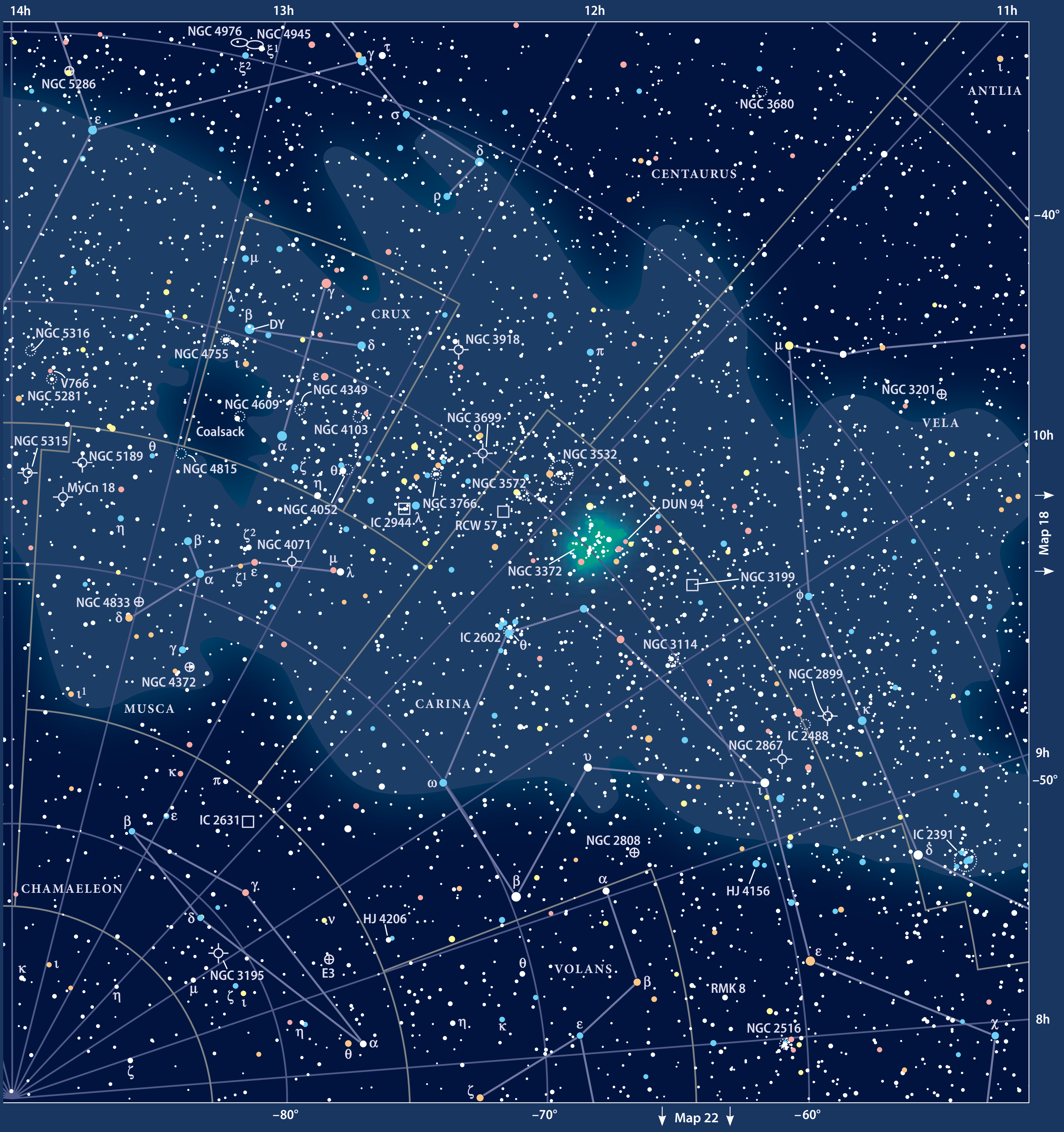
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0


14h
13h
12h
11h
10h
9h
8h
–40°
–50°
–80°
–70°
–60°
Map 18
Map 22
CENTAURUS
ANTLIA
CRUX
VELA
CARINA
MUSCA
CHAMAELEON
VOLANS
NGC 4976
NGC 4945
NGC 5286
NGC 3680
NGC 5316
NGC 4755
V766
NGC 5281
NGC 4609
NGC 4349
NGC 4103
Coalsack
NGC 3918
NGC 3201
NGC 3699
NGC 3532
NGC 5315
NGC 5189
NGC 4815
MyCn 18
NGC 4052
IC 2944
NGC 3766
NGC 3572
RCW 57
DUN 94
DY
NGC 4071
NGC 3372
NGC 3199
NGC 4833
IC 2602
NGC 3114
NGC 4372
NGC 2899
IC 2488
NGC 2867
IC 2631
NGC 2808
IC 2391
HJ 4156
HJ 4206
NGC 3195
E3
RMK 8
NGC 2516

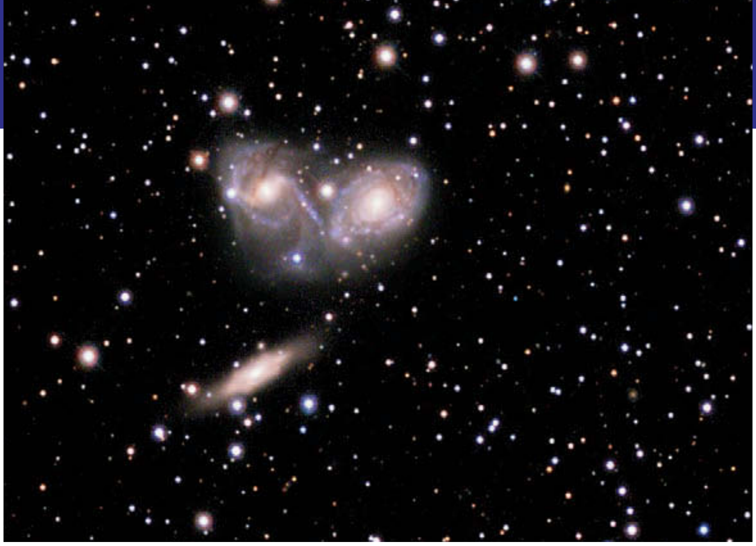
◌	Open cluster
⊕	Globular cluster
□	Diffuse nebula
⌖	Planetary nebula
⬭	Galaxy

α	Alpha
β	Beta
γ	Gamma
δ	Delta
ε	Epsilon
ζ	Zeta
η	Eta
θ	Theta
ι	Iota
κ	Kappa
λ	Lambda
μ	Mu
ν	Nu
ξ	Xi
ο	Omicron
π	Pi
ρ	Rho
σ	Sigma
τ	Tau
υ	Upsilon
φ	Phi
χ	Chi
ψ	Psi
ω	Omega

MAP 24 SOUTH POLAR 3

DANIEL VERSCHATSE

▲ **GLOBULAR CLUSTER** **NGC 6397 in Ara is visible to the naked eye from a dark site. This cluster is a good one to observe through small telescopes because of the many 10th-magnitude stars it contains.**


DANIEL VERSCHATSE

▲ **A GALACTIC TRIO** **interacts gravitationally in the northern section of Pavo. Thus, NGC 6769 (upper right), NGC 6770 (upper left), and NGC 6771 contain many new blue stars and pink star-forming regions.**

/// DOUBLE-STAR DELIGHTS — MAP 24

Designation	Right ascension	Declination	Magnitudes	Separation
Kappa Tucanae	1h16m	–68°52'	5.1, 7.3	5.2"
HDO 262	17h00m	–54°35'	5.9, 12.0	20.1"
Gamma Arae	17h25m	–56°22'	3.5, 10.5	17.9"
HJ 4978	17h50m	–53°37'	6.0, 9.0	12.3"
Xi Pavonis	18h23m	–61°29'	4.3, 8.6	3.3"
HJ 5171	20h15m	–64°26'	7.0, 10.0	17.3"
HJ 5182	20h33m	–80°58'	5.8, 11.5	26.8"
Mu Octantis	20h42m	–75°21'	7.1, 7.6	17.4"
Beta Indi	20h55m	–58°27'	3.7, 12.5	17.3"
Theta Indi	21h20m	–53°26'	4.7, 7.2	6.0"
Lambda Octantis	21h51m	–82°43'	5.5, 7.8	2.8"
Delta Tucanae	22h27m	–64°58'	4.8, 9.3	6.9"

Faint southern stars

The region of Map 24 at first seems to present a challenge. The constellations are faint, and only one 1st-magnitude star lights the way. Still, with a good telescope under a clear, dark sky, you can observe many treasures.

Point your telescope to the western edge of Pavo, near magnitude 3.6 Eta Pavonis, and you'll find the irregular galaxy **IC 4662** just 10' northeast of the star. For a better view of the magnitude 11.3 galaxy, crank up the magnification, and position Eta Pav just outside the field of view. Through a 12-inch or larger telescope, you'll be able to pick out IC 4662's large stellar association that contains two emission nebulae. This complex dominates the galaxy's appearance. IC 4662 measures 3.2' by 1.9'.

NGC 6684, a magnitude 10.4 barred spiral galaxy, lies 6° east of Eta Pav and just 10' south of Theta Pavonis. Through an 8-inch scope, you'll see a bright core surrounded by a circular halo 2' across.

Move another 3° to the east-northeast, and you'll find spiral galaxy **NGC 6744**. With a magnitude of 8.6, you might think this would be a spectacular galaxy with plenty of spiral detail. Unfortunately, that's not the case. Because the light from NGC 6744 spreads out over a large area, small and medium telescopes don't bring the spiral arms into view. The magnitude 8.0 star SAO 254453 lies 0.6° west of NGC 6744.

Through a 12-inch telescope, you'll see a bright oval measuring 5' by 3' with an even brighter core. The outer reaches of the halo appear clumpy, which suggests spiral structure, but the arms are not easy to see.

Just 4° north of NGC 6744 lies one of the sky's brightest globular clusters, **NGC 6752**. You'll have no trouble spotting this magnitude 5.3 object with your naked eyes from a dark site. Through a 6-inch telescope, you'll see hundreds of stars starting at the cluster's outer regions and continuing to the strongly concentrated core. An 8th-magnitude star lies near the southeastern edge of the densest part of the cluster. NGC 6752 looks big and bright because it's nearby, only 13,000 light-years away.

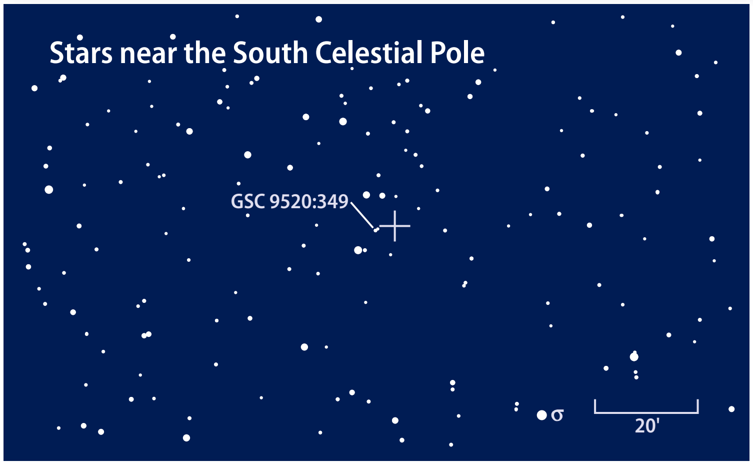
In the southern reaches of Pavo, you'll find the bright elliptical galaxy **NGC 6876** 2.5° northeast of 4th-magnitude Epsilon Pavonis. This object lies at the center of a rich galaxy cluster. A 10-inch telescope shows the evidence; it brings several fainter companions into view. NGC 6876 appears as a bright circular smudge with a fairly wide, concentrated core. Two 12th-magnitude companions, NGC 6877 and NGC 6880, lie 2' and 6' to the east, respectively. And panning 9' to the northeast will bring you to NGC 6872, a barred spiral galaxy that reveals only a faint core to all but the largest amateur telescopes.

THE RED LIMIT: OBSERVE CARBON STARS

The reddest stars get their names from the abundance of carbon that builds up on their surfaces. Because they're so red, many amateur astronomers find them fun to observe. A few had names bestowed upon them long ago, for example, Hind's Crimson Star (R Leporis), La Superba (Y Canum Venaticorum), and Herschel's Garnet Star (Mu Cephei).

Astronomer Brian Skiff at Lowell Observatory in Flagstaff, Arizona, compiled a list of the brightest "very red" stars. The stars on the list to the right are brighter than 8th magnitude, making the list an easy observing project even through a small telescope.

We determine star colors by a simple formula called the **color index**. Astronomers subtract the star's visual magnitude from its blue magnitude. A negative number indicates a blue star while a high positive number shows the star to be red. Remember, however, that your eyes are different from the observer next to you, so you may perceive color differently.



ASTRONOMY: KELLIE JAEGER

▲ **THIS CHART shows all stars near the South Celestial Pole (SCP, marked by the +) brighter than magnitude 11. Use this chart when you're south of the equator to polar-align your telescope. The star just to the lower left of the SCP is designated GSC 9520:349. The star nearest to the SCP usually visible to the naked eye is Sigma Octantis, which lies 1° 3.5' below and to the right of the pole. Sigma Oct glows at magnitude 5.45.**

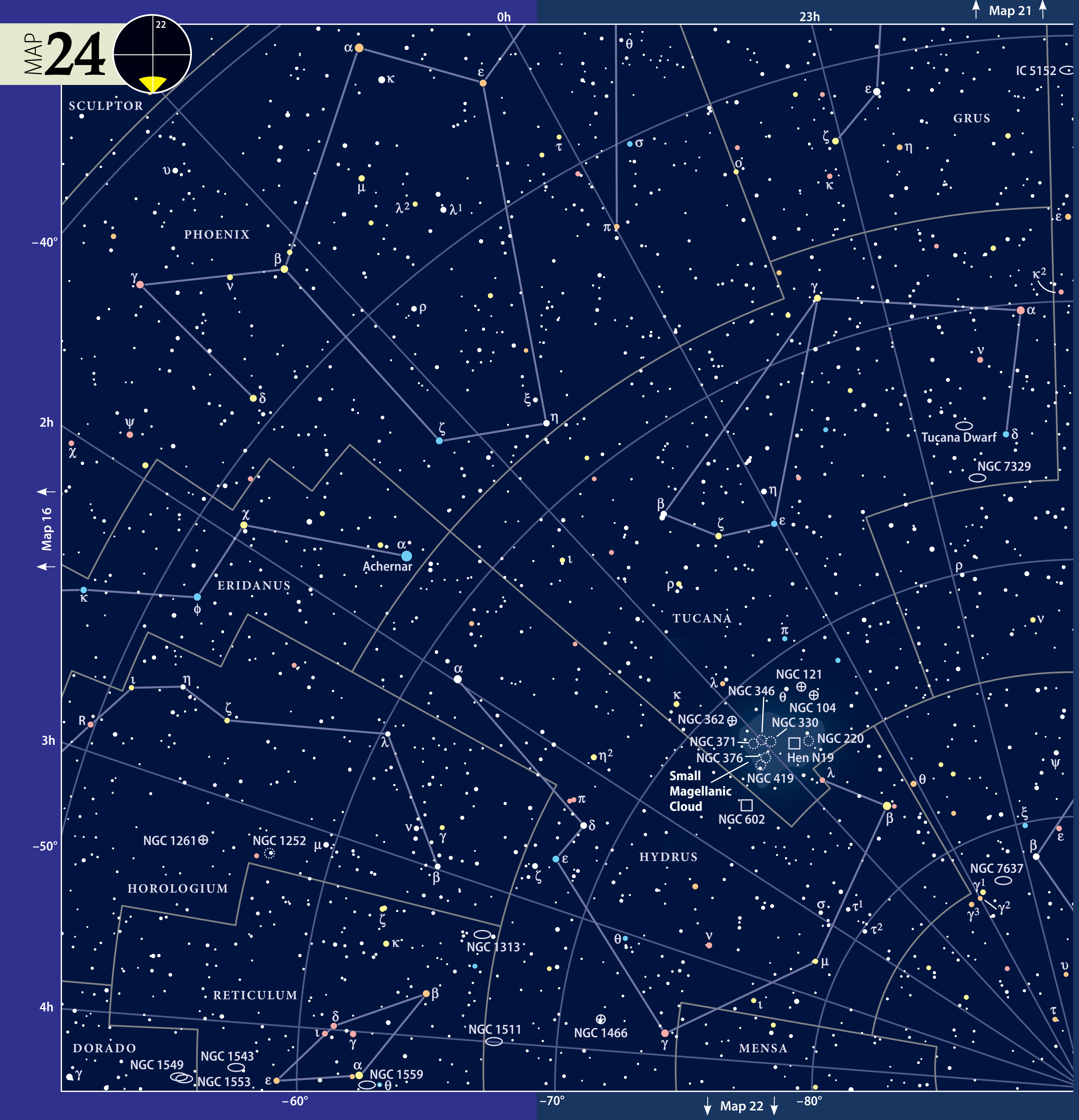
Midway between Theta and Delta Indi lies the fine spindle of **NGC 7090**. At a distance of just 20 million light-years, this spiral galaxy extends a full 6' in an 8-inch scope. It's also reasonably bright, glowing at magnitude 10.7. The galaxy's disk inclines just 5° to our line of sight and measures less than 1' wide. Use a 12-inch telescope, and you'll see a broad, concentrated center. Any further detail, such as mottling in the spiral arms, takes a much larger scope.

In Octans, you can find **NGC 7098** lying pretty much alone. Through a 12-inch telescope, the galaxy measures 3' by 2' and appears somewhat stretched on a northeast-to-southwest line. The galaxy is moderately bright (magnitude 11.4), and it has a broad, concentrated center. Look for a pair of 11th- and 12th-magnitude stars 6' to the southwest.

Remember Kemble's Cascade (see page 4)? A similar object — **Melotte 227** — lies in the southernmost constellation, Octans. Melotte 227 looks like an open cluster containing about 20 stars between magnitudes 7 and 10. In 1998, however, astronomers learned the stars don't share a common motion through space but are a random concentration of stars at various distances. Still, it's worth a look through binoculars or a telescope/eyepiece combination that gives at least a 2° field of view.

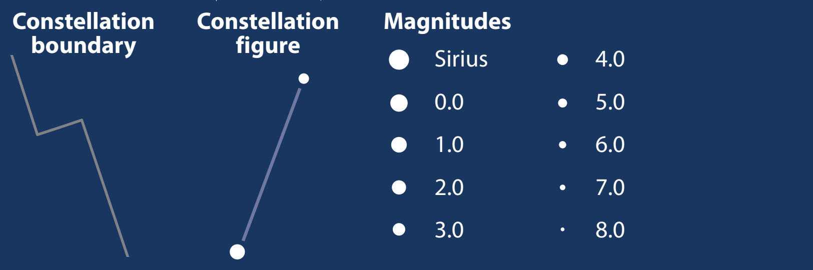
THE REDDEST BRIGHT STARS

Designation	Right ascension	Declination	Magnitude	Color index	Map
R Scl	1h27m	–32°33'	5.8	3.9	16
TW Hor	3h12m	–57°19'	5.7	2.3	22
R Dor	4h37m	–62°05'	5.5	1.6	22
R Lep	4h59m	–14°48'	7.7	5.7	11
W Ori	5h05m	1°11'	6.2	3.5	11
CE Tau	5h32m	18°36'	4.4	2.1	5
W Pic	5h43m	–46°27'	7.8	4.8	17
Y Tau	5h46m	20°42'	7.0	3.0	5
BL Ori	6h25m	14°43'	6.2	2.4	11
UU Aur	6h37m	38°27'	5.3	2.6	5
NP Pup	6h54m	–42°22'	6.3	2.3	17
W CMa	7h08m	–11°55'	6.9	2.5	11
X Cnc	8h55m	17°14'	6.6	3.4	12
Y Hya	9h51m	–23°01'	6.6	3.8	18
X Vel	9h55m	–41°35'	7.2	4.3	18
AB Ant	10h12m	–35°19'	6.7	2.3	18
U Ant	10h35m	–39°34'	5.4	2.9	18
U Hya	10h38m	–13°23'	4.8	2.8	12
VY UMa	10h45m	67°25'	6.0	2.4	2
V Hya	10h52m	–21°15'	6.8	5.5	18
SS Vir	12h25m	0°48'	6.6	4.2	13
Y CVn	12h45m	45°26'	4.9	2.5	7
RY Dra	12h56m	65°59'	6.4	3.3	2
UY Cen	13h17m	–44°42'	6.9	2.8	19
V766 Cen	13h47m	–62°35'	6.5	2.0	23
X TrA	15h14m	–70°05'	5.8	3.6	23
TW Oph	17h30m	–19°28'	7.9	4.8	20
V Pav	17h43m	–57°43'	6.7	4.2	24
T Lyr	18h32m	36°59'	8.5	5.5	8
V450 Sct	18h33m	–14°52'	5.5	2.0	14
S Sct	18h50m	–7°54'	7.5	3.1	14
V Aql	19h04m	–5°41'	7.5	4.2	14
V1942 Sgr	19h19m	–15°55'	6.9	2.3	14
UX Dra	19h22m	76°34'	5.9	2.9	3
AQ Sgr	19h34m	–16°22'	7.3	3.4	14
RT Cap	20h17m	–21°19'	7.4	4.0	21
T Ind	21h20m	–45°01'	6.0	2.4	21
Y Pav	21h24m	–69°44'	6.4	2.8	24
V460 Cyg	21h42m	35°31'	6.1	2.5	9
Mu Cep	21h44m	58°47'	4.1	2.3	3
Pi^1 Gru	22h23m	–45°57'	6.6	2.0	21
RW Cep	22h23m	55°58'	6.7	2.3	3
TX Psc	23h46m	3°29'	5.0	2.6	15


MAP 24
22
0h
23h
Map 21
SCULPTOR
GRUS
PHOENIX
ERIDANUS
Achernar
TUCANA
HYDRUS
HOROLOGIUM
RETICULUM
DORADO
MENSA
IC 5152
Tucana Dwarf
NGC 7329
NGC 121
NGC 346
NGC 104
NGC 362
NGC 330
NGC 371
NGC 220
NGC 376
Hen N19
Small Magellanic Cloud
NGC 419
NGC 602
NGC 1261
NGC 1252
NGC 7637
NGC 1313
NGC 1511
NGC 1466
NGC 1549
NGC 1543
NGC 1553
NGC 1559
-40°
-50°
2h
3h
4h
Map 16
-60°
-70°
-80°
Map 22

SOUTH POLAR 3

From southern latitudes, you'll see this map's area best in August. Most of these objects are invisible to Northern Hemisphere observers.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Constellation figure
Magnitudes
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5.0
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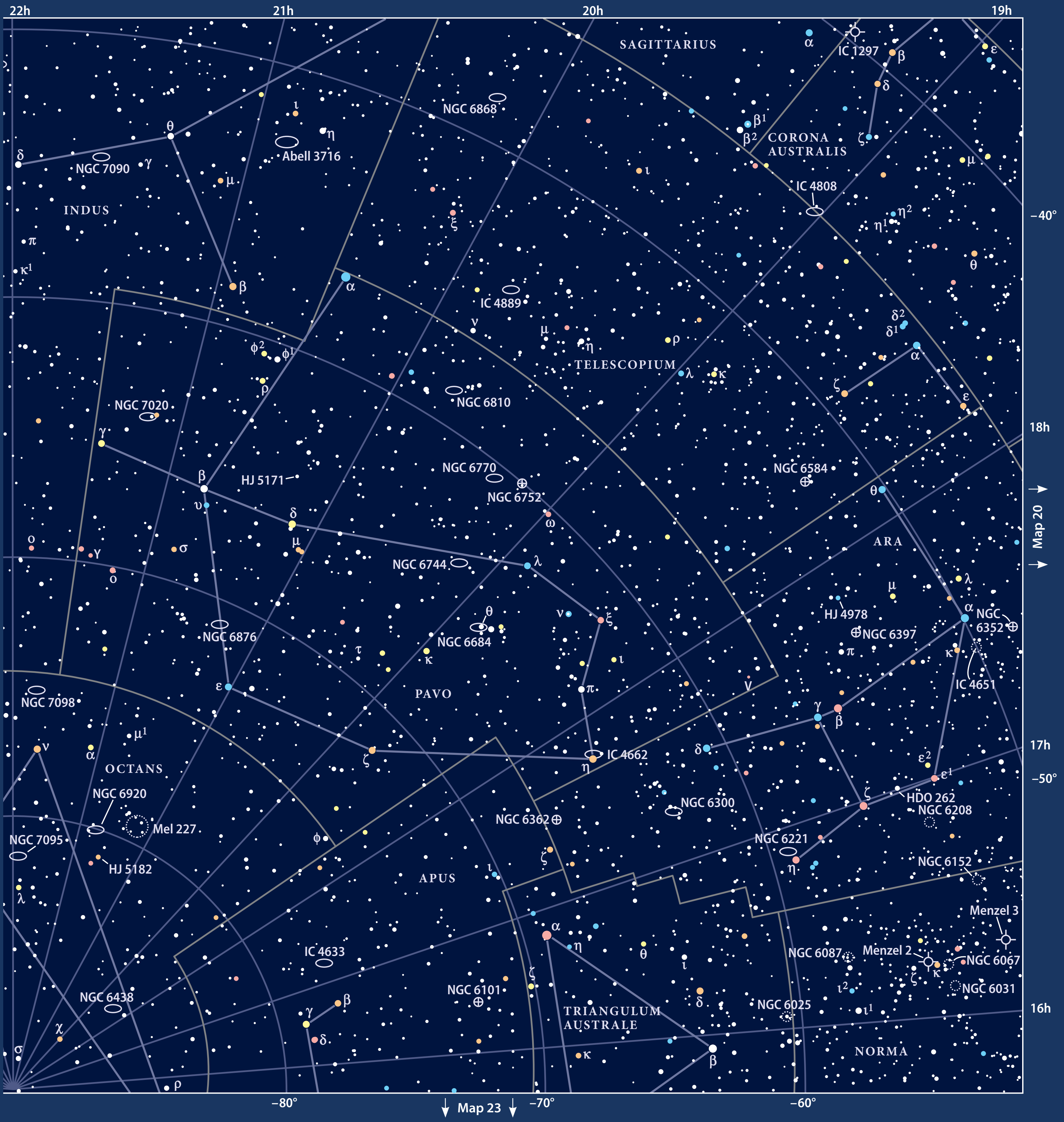
8.0


22h
21h
20h
19h
SAGITTARIUS
α
IC 1297
β
ε
δ
NGC 6868
ι
η
θ
β1
β2
CORONA AUSTRALIS
ζ
δ
NGC 7090
γ
Abell 3716
ι
μ
μ
IC 4808
INDUS
ξ
η2
η1
−40°
π
κ1
θ
β
α
IC 4889
δ2
δ1
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TELESCOPIUM
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NGC 6810
NGC 7020
ε
18h
γ
NGC 6770
NGC 6584
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HJ 5171
NGC 6752
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Map 20
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ARA
NGC 6744
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HJ 4978
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NGC 6352
NGC 6876
NGC 6684
NGC 6397
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IC 4651
PAVO
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π
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NGC 7098
γ
β
17h
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μ1
ζ
IC 4662
ε2
α
η
ε1
OCTANS
−50°
ν
NGC 6920
NGC 6300
ζ
HDO 262
NGC 6208
Mel 227
NGC 6362
NGC 7095
NGC 6221
φ
ζ
η
NGC 6152
HJ 5182
APUS
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Menzel 3
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IC 4633
NGC 6087
Menzel 2
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NGC 6067
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ζ
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NGC 6031
NGC 6438
NGC 6101
β
γ
δ
ι2
NGC 6025
ι1
χ
TRIANGULUM AUSTRALE
16h
δ
σ
κ
β
NORMA
ρ
−80°
Map 23
−70°
−60°

◌ Open cluster

⊕ Globular cluster

□ Diffuse nebula

⌖ Planetary nebula

⬭ Galaxy

α	Alpha	η	Eta	ν	Nu	τ	Tau		
β	Beta	θ	Theta	ξ	Xi	υ	Upsilon		
γ	Gamma	ι	Iota	ο	Omicron	φ	Phi		
δ	Delta	κ	Kappa	π	Pi	χ	Chi		
ε	Epsilon	λ	Lambda	ρ	Rho	ψ	Psi		
ζ	Zeta	μ	Mu	σ	Sigma	ω	Omega		

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Telescope

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